Gold mine of research for Health and Environment

Dr. Shibabrata Pattanayak

GOLD MINE OF RESEARCH FOR HEALTH AND ENVIRONMENT

(Twenty editorials covering the most important areas of future research)

Dr. Shibabrata Pattanayak

B.V.Sc. & A.H.; M.V.Sc. (Immunology, I.V.R.I); NET (Microbiology); P.G.D.R.D.; F.M.D.I.T.;
Ph. D. (Pharmacology, W.B.U.H.S.).

Gold mine of research for health and environment
By
Dr. Shibabrata Pattanayak

ISBN: 978-93-5655-393-4

© Published by :
Dr. Shibabrata Pattanayak
Address : 81/A, Mahatma Gandhi Road,
Karunamoyee More, Tolleyganj,
Kolkata - 700041, India.

E-mail: pattanayak1966@gmail.com

Drafted by:
Shri Krishna Laser & Graphics
52B, Bidhan Sarani
Kolkata-700 006

Dedicated to :
All future researchers interested in out of the track research for healthcare and protection of the environment.

PREFACE

During my tenure as associate editor or editor of the journal Exploratory Animal and Medical Research (EAMR), I considered writing a new type of editorial highlighting some important problems related to health, the environment, and neglected topics linked to the existence of human civilization. A total of twenty such articles were written and published during the period from 2013 to 2025. In the articles, the problem areas of the topics are documented, and ways to solve such problems are searched from available sources and concepts.

For easy availability of these topics to frame research projects or further study, the articles are brought together in this book.

I expect that for the researchers who have the desire to engage in the way of countering or avoiding important problems related to health and environment, this book will be beneficial. All kind of assistance from my end in such an endeavor is always available for all people interested to start such a journey.

With warm regards to every reader of this book,

Dated, Kolkata, the 16th January, 2026

Dr. Shibabrata Pattanayak
81/A, Mahatma Gandhi Road,
Karunamoyee More, Tolleyganj,
Kolkata - 700041, India

Editorials			
Sl. No.	**Title**	**Journal and Issue**	**Year of publication**
1.	Neglected areas of phyto-medicinal research	EAMR, Vol 15, Issue 2	2025
2.	Psycho-neuro-immuno-endocrinology: study of the key Factors of disease creation	EAMR, Vol 14, Issue 2	2024
3.	Biological age and lifestyle: key deciding factors of aging and disease susceptibility	EAMR, Vol 14, Issue 1	2024
4.	Limitations of the contemporary vaccines: how to overcome?	EAMR, Vol 13, Issue 2	2023
5.	Attenuated and modified vaccine viruses: do they act as a source of some other viral diseases?	EAMR, Vol 13, Issue 1	2023
6.	Plastics and their additives reached the blood and tissue spaces: what are the possible consequences?	EAMR, Vol 12, Issue 2	2022
7.	Research targeting business profits: impacts on health and environment	EAMR, Vol 12, Issue 1	2022
8.	Plants in healthcare: past, present and future	EAMR, Vol 11, Issue 2	2021
9.	Dietary modulation with fatty acids: a potential way to Overcome covid-19	EAMR, Vol 10, Issue 2	2020
10.	Trans-fats of processed and fried foods – a choice for taste or serious health problems?	EAMR, Vol 9, Issue 1	2019
11.	Thrown plastics – cause of an incoming global disaster	EAMR, Vol 8, Issue 2	2018
12.	Mobile phone and tower radiation: a challenge to all living entities	EAMR, Vol 8, Issue 1	2018
13.	Processed foods – are they safe?	EAMR, Vol 7, Issue 2	2017
14.	Alternative to antibiotics - preparation for post antibiotic era	EAMR,Vol. 7, Issue 1	2017
15.	Slow poisoning through water intake -- are we conscious?	EAMR, Vol 6, Issue	2016
16.	Incoming water crisis in india : as understood by others	EAMR, Vol 5, Issue 2	2015
17.	Wastage of underground water – steps towards a trap?	EAMR,Vol. 5, Issue 1	2015
18.	Cancer – the ultimatum from our chemical based civilization	EAMR, Vol 4, Issue 1	2014
19.	Human health impact of bovine beta-casomorphin-7 of milk - a question for milk products or our breeding policy?	EAMR, Vol 3, Issue 2	2013
20.	Use of 'vaccine vial monitor' in all animal and bird vaccines – a demand of the day	EAMR, Vol 3, Issue 1	2013

Explor Anim Med Res.
Vol. 15, Issue 2, 2025
DOI: 10.52635/eamr/15.2.155-159

ISSN 2277-470X (Print), ISSN 2319-247X (Online)
Website: www.animalmedicalresearch.org

Published under the CC BY-NC 4.0 license

Editorial

NEGLECTED AREAS OF PHYTO-MEDICINAL RESEARCH

Shibabrata Pattanayak*

ABSTRACT: The contemporary phytomedicine research is engaged principally towards the target of identification of active principles of the diluents-extracted section of the dry parts of the medicinal plants. Thus, medicinal plants are used in the modern healthcare system almost solely as a source of knowledge for getting efficient molecule/s for synthesizing marketable new drugs. But plants can influence the overall health status in positive directions in various different ways. On the other hand, health status and susceptibility to diseases of an individual is dependent on many factors, like the biological age of the individual, expression or suppression of the genetic predisposition to diseases, etc. All such factors can be controlled or modified in positive directions through following a designed lifestyle and food-drink style, by closing the entry of different synthetic chemicals inside the body, etc. Positive effects of some specific foods, like succulent vegetable salad, fruit salad, nut mixture, spice mixture, etc., in the daily diet can influence the innate immunity of the body to a large extent and thus can control initiation, progression, and severity of diseases. Along with these, the use of synthetic chemical-free succulent biomedicines can act as a better alternative to the presently synthetic chemical-based treatment practices of modern medicine.

Keywords: Phytomedicine, Drug development, Active principle, Biological age, Succulent biomedicine, Neglected research.

INTRODUCTION

Source of a very good portion of the drugs used in modern medicine is directly or indirectly linked with different plants [1, 2, 3]. Following the principle of identification and mass production of identified active agent/s from the plant source, most of such drugs were developed. Plants have immense possibilities in healthcare, but many of the potential areas are not considered for intense study. The presently practiced uni-directed techniques of research towards drug development in modern medicine, as well as the use of the knowledge of the codified ancient healthcare systems practiced in the present time, have many conceptual limitations that demand attention from the research communities.

USE OF MEDICINAL PLANTS IN THE ANCIENT SOCIETIES

Plants have been treated as a preventive and therapeutic means to control different diseases from a very ancient time. In ancient societies, the locally available plants were used for such purposes, mainly just after collection [1, 4]. Such practices are still observed among animals genetically near or even far away from human [5]. Such uses of plants as some medicines at their raw, succulent stage are still practiced by many ethnic and rural people [1, 6].

But not all medicinal plants grow during all the seasons of the year. Many of them grow only in some specific conditions of soil and climate, and so were not available in many other places. So, these were having the constraints of regional and seasonal availability. To overcome that problem, storage of the parts of the medicinal plants was considered. As there was no other option for the storage of such medicines in most parts of the world during ancient time, storage of the dry parts of the medicinal plant was the only way left to overcome these problems. Afterwards, the use of only the dry parts of the medicinal plants becomes a practice in human society [1, 6, 7].

DEVELOPMENT OF THE CODIFIED SYSTEMS OF ANCIENT HEALTHCARE AND THEIR LIMITATIONS

Along with the development of the language and writing capabilities, the knowledge gathered and passed through generations by the way of verbal teaching was noted in many parts of the world [1, 7]. But probably

Former Editor, Exploratory Animal and Medical Research
**Corresponding author. e-mail: pattanayak1966@gmail.com*

portions of such knowledge among the ethnic people who live in remote areas were left outside of such documentation. On the other hand, along with the passing of time, the ancient names of the plants documented in the codified systems are forgotten in many cases, and many plant species become extinct [1, 6, 7].

USE OF MEDICINAL PLANTS IN THE MODERN SOCIETIES

Identification of plants and use of the procedures described in the codified systems

In the present time, the identified plants and techniques described in the ancient codified systems are adopted and used as a means of healthcare in the name of alternative medicines. But only the techniques of use of dry parts of the medicinal plants are accepted in that journey, though there were descriptions of other techniques also in the ancient texts [1, 6, 8]. The dry parts of the plants, singly or at different combinations in the name of poly-herbal medicines are used in such healthcare systems. These plants are used either directly or after mixing with some vehicle or in the form of alcoholic extracts.

Modification and adaptation of new available procedures of modern medicine are in practice during the use of such codified knowledge in healthcare, though some criticisms are there in the steps of validation, standardization, technique adaptation, and impact studies of such medicines [9, 10, 11].

Concept of use of ethno-medicinal knowledge to prepare usable drugs of modern medicine

The medicinal plants are treated with almost the same concept of drug development as the other sources, following different chemical means. The dried parts of the medicinal plants are used to validate their reported efficacies, and after getting positive results in such studies, efforts are made to identify the active portions (principles) of such dry parts of the medicinal plants. The solvent extracted sections of the dry parts of the medicinal plants are considered equal or representative of the original medicinal plants in such procedures. If a negative result comes during validation of such solvent-extracted parts, the ethno-medicinal reports of efficacy of such plants are almost considered wrong [12, 13, 14].

The solvent extracted sections of the dry part of the medicinal plants are used to identify the bioactive compounds, termed as active principles. Individually, such active principles are tested for their efficacy and toleration level in the human or animal body following different techniques of safety and efficacy studies. After passing all such tests, the compound/s are synthesized at bulk quantities to market them as some drugs [1, 15]. Alternatives to such a unidirectional procedure of validation and use of medicinal plants in healthcare are already proposed, though not studied thoroughly [5, 32, 35].

Framework developed for drug development using plants as a knowledge source

For the development of marketable drugs after getting the knowledge from the reported medicinal plants, a huge infrastructure has been established throughout the globe. Over 60 such phytochemical databases are identified by the researchers [16]. A huge amount of fund are used continuously to develop effective drugs to combat important diseases like diabetes [17, 18, 19] or cancers [20, 21, 22] with very limited success [23, 24, 25]. The target of making a profit by business may be a more potent inspiring force acting behind such efforts than the benefit of humankind [26].

THE CONCEPTUAL GAPS

In the codified systems practiced presently

In many ancient healthcare systems, the use of different forms of the medicinal plant parts is described for their efficient uses [27, 28, 29]. Among them, only the dry parts of the medicinal plants are considered as the only form to prepare usable medicines in the present time. On the other hand, many other techniques of modern medicine are adopted for the production and marketing of such coded medicines, though many of them are not described in the related ancient texts [14, 30, 31].

In modern medicine

For validation of the traditional claims of the ethnomedicinal systems, the therapeutic efficacies are not tested on any animal or human. Even for the plant parts used in healthcare purposes by different ethnic groups for centuries without any report of any untoward effects, the same procedures of solvent extracted from the dry parts of the reported plants are analyzed for certification of their non-toxicity and efficacies. Many plant parts are used as some succulent foods by some people or groups of people, but they are also treated in the same way [1, 13].

The main target of the contemporary research on medicinal plants is the identification of effective (active) principles to synthesize chemically in bulk quantities to get business [19, 32]. Perhaps due to consideration of only that target, possible combinational effects of known or unknown phytochemicals present in the succulent state of even a single medicinal plant are overlooked and not considered important [1, 32].

THE NEGLECTED AREAS OF RESEARCH

A. Prevention of diseases by means other than vaccination or drug-based treatment

Body immunity can be roughly divided into two parts: the innate or non-specific immunity and the acquired immunity. The innate immunity covers all the soldiers and weapons the living body has, develops from the zygote stage, and is modified lifelong. The acquired immunity is acquired during encounters with disease agents or vaccination antigens. The innate immunity actually acts as the first line of defense of the body.

Many trials are performed, and huge research has been done for the modification of the acquired immunity status of the body by vaccination, the use of drugs, and other techniques. But research for modulation of innate or non-specific immunity of the body to prevent catching of the diseases or expression of the genetic predisposition to various diseases is scarce [32, 33].

1. Following a designed lifestyle

Correction of the habits of use of different synthetic chemical-based products in all aspects of the daily routine can reduce the entry of different synthetic chemicals of different nature into the body. Staying away from the processed foods containing a huge number of synthetic chemicals of different categories (preservatives, stabilizers, added flavors, colors, etc.), mixture of different chemicals in the name of cold drinks or chemical-made or added fruit juices [34, 35], the trans fats of the oils used [36], different cheap, adulterated foods; micro and nano-plastics, etc., most of which are having serious toxic effects on the body, can reduce increase of load of these chemicals inside our body [34, 35, 37].

Use of different skin-care, hair-care, health-care, cosmetic, etc. products with different mixtures of synthetic chemicals and their absorption through skin is another serious subject in this regard [35, 38, 32]. Staying away from these practices is also important [32, 39].

Alternatives to these so-called healthcare products in the category of cosmetics, skin care products, etc., can be prepared totally from herbs without the addition of any synthetic chemicals for their regular use following the ethno-medicinal knowledge [35].

2. Immuno-modulation through food

Modification of food habits by inclusion of nut mixture, succulent vegetable salad, fruit salad, and spice mixture in the diet can modify the innate immunity to a large extent to strengthen our overall disease preventing power of the body. There are at least 124 edible succulent vegetables and also 124 edible succulent fruits, having different possible mechanisms of actions to modify the immunity status of the body [32].

3. Succulent biomedicines

The related parts of the reported medicinal plants (fruit, leaf, root, stem, flower, etc.) can be used directly as edible medicine in the encapsulated form without the addition of any synthetic chemical following some specific production design [19, 40, 41].

For the preparation of succulent biomedicines to prevent or cure different diseases, plant sources are already available. There are reports of 800 medicinal plants with anti-diabetic activities, 934 plants with anti-cancer activities, 130 plants with immunomodulation activities, 78 plants with antiviral activities, and 1200 plants with anti-microbial activities. Among all these lists, many plants are found commonly. So, possibly they can act against different diseases with different mechanisms of action [32].

4. Following of near-nature lifestyle

The nature attached lifestyle can add some positive force in life, so it can influence the immunity status of the body. It is already established that the mental status (psychology) of individuals can control overall neuronal systems, the endocrine system, and immunity of the body. Nature-attached lifestyle can also strongly influence these factors [32, 42]. Following a pre-designed lifestyle with regular exposure to sunlight, physical and mental exercises (as follows the techniques of removal of stress), maintenance of body clock, spending time in nature without electronic gadgets, etc., can reduce the biological age by modulating the body's immunity status [32, 43].

B. Study of the possible mechanism of action of the alternatives proposed

Along with fewer entries and the formation of different toxins in the body, the immunity status will improve. The catching of different diseases and initiation of so-called lifestyle diseases will be reduced for such habits.

As per a few studies found, immunomodulation by antioxidation is considered as the way to show the activities of the succulent biomedicines. But these are some broad terms, containing different ways and means. There may be other possible mechanisms related with masking of genetic pre-disposition towards initiation of various diseases, potentiation of some procedures of innate immunity, suppression of some detrimental procedures of the body like development

of autoimmunity, etc., particularly by the metabolic products of the succulent fruits, nuts, vegetables and the biomedicines inside the body system, both in case of limited time medicinal use, and more importantly, as a result of their continuous use as a part of the lifestyle followed [1, 19, 32].

CONCLUSION

Plant is mainly considered as the source of information related to the development of some drugs of synthetic origin to use them in modern medicine. But that concept covers only a part of the capability of the plants to influence our health and overall well-being. Different other ways like modification of different detrimental parameters of lifestyle, modification food style, inclusion of nature as a part of life, use of healthcare products of raw herbal origin and widespread use of succulent biomedicine capsules for healthcare practices can change the entire scenario of presently practiced chemical based healthcare procedures along with the side effects of the drugs and the huge expenditure related with it.

REFERENCES

1. Pattanayak S. Plants in healthcare: past, present and future. Explor Anim Med Res. 2021; 11(2): 140-144, DOI: 10.52635/eamr11.2.140-144.

2. Davis CC, Choisy P. Medicinal plants meet modern biodiversity science, Current Biology, 2024; 34(4): R158-R173, DOI:10.1016/j.cub.2023.12.038.

3. Xie S, Zhan F, Zhu J, Xu S, Xu J. The latest advances with natural products in drug discovery and opportunities for the future: a 2025 update. Expert Opinion Drug Discov. 2025; 20(7): 827–843, DOI: 10.1080/17460441.2025.2507382.

4. Capasso L. 5300 years ago, the Ice Man usednatural laxatives and antibiotics. Lancet. 1998; 352(9143): 1864, DOI: 10.1016/S0140-6736(05)79939-6.

5. Pattanayak S. Self-treatment among animals by using succulent herbs to fight against parasites and their possible use as human medicine. Explor Anim Med Res. 2024; 14(Parasitology Spl.), DOI: 10.52635/eamr/14(S1)18-28.

6. Pattanayak S. Succulent biomedicines – an effective way of getting protection against diseases through immuno-modulation. Explor Anim Med Res. 2020; 10(2): 112-123.

7. Chauhan A, Semwal DK, Mishra SP, Semwal RB. Ayurvedic research and methodology: Present status and future strategies. Ayu. 2015; 36(4): 364-369, DOI:10.4103/0974- 8520.190699.

8. Balkrishna A, Sharma N, Srivastava D, Kukreti A, Srivastava S, Arya V. Exploring the safety, efficacy, and bioactivity of herbal medicines: Bridging traditional wisdom and modern science in healthcare. Future Integr Med. 2024;3(1): 35-49, DOI: 10.14218/FIM.2023.00086.

9. Parveen A, Parveen B, Parveen R, Ahmad S. Challenges and guidelines for clinical trial of herbal drugs. J Pharm Bioallied Sci. 2015; 7(4): 329-333, DOI: 10.4103/0975-7406.168035.

10. Wang H, Chen Y, Wang L, Liu Q, Yang S, Wang C. Advancing herbal medicine: enhancing product quality and safety through robust quality control practices. Front Pharmacol. 2023;14:1265178, DOI: 10.3389/fphar.2023.1265178.

11. Jadhav R, Das J, Rajyaguru S. *et al.* Regulations, current development, and future prospects of phytopharmaceuticals, a new class of herbal medicines in India. Discov Pharm Sci. 2025; 1: 6, DOI: 10.1007/s44395-025-00006-4.

12. Katiyar C, Gupta A, Kanjilal S, Katiyar S. Drug discovery from plant sources: An integrated approach. Ayu. 2012; 33(1):10-19, DOI: 10.4103/0974-8520.100295.

13. Pattanayak S, Mandal TK, Bandyopadhyay SK. Validation and therapeutic use of succulent plant parts - opening of a new horizon of alternative medicine. Explor Anim Med Res. 2016; 6(1): 8-14.

14. Chaachouay N, Zidane L. Plant-derived natural products: A source for drug discovery and development. Drugs Drug Candidates. 2024; 3(1): 184-207, DOI: 10.3390/ddc3010011.

15. Seidel V. Plant-derived chemicals: A source of inspiration for new drugs. Plants (Basel). 2020; 9(11): 1562, DOI: 10.3390/plants9111562.

16. Ingle SG, GadeAK., Hedawoo GB. Systematic review on phytochemicals structure and activity databases. http://dx.doi.org/10.2139/ssrn.4818928.

17. Omale S, Amagon KI, Johnson TO, Bremner SK, Gould GW. A systematic analysis of anti-diabetic medicinal plants from cells to clinical trials. Peer J. 2023; 11: e14639, DOI: 10.7717/peerj.14639.

18. Gaonkar VP, Hullatti K. Indian traditional medicinal plants as a source of potent anti-diabetic agents: A review. J Diabetes Metab Disord. 2020;19(2):1895-1908, DOI: 10.1007/s40200-020-00628-8.

19. Pattanayak S. Prevention and control of diabetes by intake of succulent biomedicines and following of designed lifestyle: A ready plan for execution. Internati J Scientif Res Updates. 2022; 03(02): 81-103, DOI: 10.53430/ijsru.2022.3.2.0047.

20. Garcia-Oliveira P, Otero P, Pereira AG, Chamorro F, Carpena M, *et al*. Status and challenges of plant-anticancer

compounds in cancer treatment. Pharmaceuticals (Basel). 2021; 14(2): 157, DOI: 10.3390/ph14020157.

21. Rudzińska A, Juchaniuk P, Oberda J, Wiśniewska J, Wojdan W, *et al.* Phytochemicals in cancer treatment and cancer prevention-review on epidemiological data and clinical trials. Nutrients. 2023; 15(8): 1896, DOI: 10.3390/nu15081896.

22. Greenwell M, Rahman PK. Medicinal plants: their use in anticancer treatment. Int J Pharm Sci Res. 2015; 6(10): 4103-4112, DOI: 10.13040/IJPSR.0975-8232.6(10).4103-12.

23. Amin A, Gali-Muhtasib H, Ocker M, Schneider-Stock R. Overview of major classes of plant-derived anticancer drugs. Int J Biomed Sci. 2009; 5(1): 1-11.

24. Paller CJ, Denmeade SR, Carducci MA. Challenges of conducting clinical trials of natural products to combat cancer. Clin Adv Hematol Oncol. 2016; 14(6): 447-455.

25. Jugran AK, Rawat S, Devkota HP, Bhatt ID, Rawal RS. Diabetes and plant-derived natural products: From ethnopharmacological approaches to their potential for modern drug discovery and development. Phytother Res. 2021; 35(1): 223-245, DOI: 10.1002/ptr.6821.

26. Pattanayak S. Research targeting business profits: impacts on health and environment. Explor Anim Med Res. 2022; 12(1): 1-7, DOI: 10.52635/eamr/ 12.1.1-7.

27. Wisdom of sages : Holistic health and well-being – Plants and herbs. https://baldmanoftea.com/wisdom-of-sages-holistic-health-and-well-being-plants-and-herbs/

28. Kapoor R, Vaidya N, Srivastva R. Different usable parts of plants (*Prayojyanga)* and their collection periods *(Sangrahankala)* mentioned in Ayurveda.World J Pharmaceut Medic Res. 2019; 5(8): 162-165.

29. Patil S, Gupta LN. Applications of Ayurvedicavaleha: A review through Charak chikitsasthana. Internati J Creative Res Thoughts. 2023; 11(6): e927-e 953.

30. Chavan S, Gupta V, Deshmukh V, Sardeshmukh S. Integrating Ayurvedic philosophy with modern technologies for drug research and development: A critical need of mechanistic insights for wider acceptability, J Ayurveda Integrative Medic. 2024; 15(5): 100954, DOI: 10.1016/j.jaim.2024.100954.

31. Chopra A, Saluja M, Tillu G. Ayurveda-modern medicine interface: A critical appraisal of studies of Ayurvedic medicines to treat osteoarthritis and rheumatoid arthritis. J Ayurveda Integr Med. 2010; 1(3):190-198,DOI: 10.4103/0975-9476.72620.

32. Pattanayak S. Therapeutic use of plant parts as food or medicine at succulent state: an alternative healthcare system for the prevention and treatment of diseases. Discover Plants. 2025; 2: 35, DOI: 10.1007/s44372-025-00111-9.

33. Pattanayak S. Limitations of the contemporary vaccines: how to overcome? Explor Anim Med Res. 2023; 13(2), DOI: 10.52635/eamr/13.2.140-145.

34. Pattanayak S. Processed foods - are they safe? Explor Anim Med Res. 2017; 7(2): 125-131.

35. Pattanayak S. Healthcare system using succulent parts of plants, Volume II: Steps for production and marketing of some selected healthcare products. 2019a; ISBN: 978–93–5391–625–1.

36. Pattanayak S. Trans-fats of processed and fried foods – a choice for taste or serious health problems? Explor Anim Med Res. 2019b; 9(1): 5-14.

37. Pattanayak S. Homo sapiens: Are the species making themselves extinct? Academia Letters, Article No. 1617. 2021; https://doi.org/10.20935/AL1617.

38. Pattanayak S. Plastics and their additives reached the blood and tissue spaces: what are the possible consequences? Explor Anim Med Res. 2022;12(2): 128-133, DOI: 10. 5263/eamr/12.2. 128- 133.

39. Halla N, Fernandes IP, Heleno SA, Costa P, Boucherit-Otmani Z *et al.* Cosmetics preservation: a review on present strategies. Molecules. 2018; 23(1571): 1-41.

40. RoyChowdhury B. DIP diet plan. 2021; https://dipdiet. in/ wp- content/ uploa ds/ 2021/ 06/ Dip- Diet- Plan-1. pdf.

41. Pattanayak S. Anti-cancer plants and their therapeutic use as succulent biomedicine capsules. Explor Anim Med Res. 2023; 13(Ethnomed.Spl.), DOI: 10.52635/eamr/13(S)01-50.

42. Pattanayak S. Psycho-neuro-immuno-endocrinology: study of the key factors of disease creation. Explor Anim Med Res. 2024; 14(2), DOI:10.52635/eamr/14.2.164-171.

43. Pattanayak S. Biological age and lifestyle: key deciding factors of aging and disease susceptibility. Explor Anim Med Res. 2024; 14(1), DOI: 10.52635/eamr/14.1.1-5.

Cite this article as: Pattanayak S. Neglected areas of phyto-medicinal research. Explor Anim Med Res. 2025; 15(2), DOI: 10.52635/eamr/15.2.155-159.

Explor Anim Med Res.
Vol. 14, Issue 2, 2024
DOI: 10.52635/eamr/14.2.164-171

ISSN 2277-470X (Print), ISSN 2319-247X (Online)
Website: www.animalmedicalresearch.org

Published under the CC BY-NC 4.0 license

Editorial

PSYCHO-NEURO-IMMUNO-ENDOCRINOLOGY: STUDY OF THE KEY FACTORS OF DISEASE CREATION

Shibabrata Pattanayak*

ABSTRACT: Psychological stressors can show their negative effects on an individual's mental and physical states. Following the psycho-neuro-immuno-endocrine axis, they can influence different internal organs and systems of the body. Such influence can affect the hypothalamus-pituitary-adrenal axis and modify the secretion of different neuroendocrine mediators. Altered secretions of neurotransmitters, neuropeptides, and other cytokines and chemokines (including pro-inflammatory cytokines); corticosteroids, catecholamines, etc. can initiate or potentiate health problems of different types and magnitudes. Psychological stressors can affect feeding, social behavior, pain sensation, learning, memory, reproduction, etc. They may act as the root for the development of conditions like epilepsy, hysteria, dementia, melancholia, psychosis, movement disorders, etc. Anxiety, confusion, depression, memory issues, problems in decision-making, attraction to negative thoughts, difficulty in focusing, lack of self-confidence, emotional disturbances, sudden changes of mood, increased irritability, unhappiness, hopelessness, inability to relax, etc. are some common effects of stress. Physiological conditions like headache, migraine, increased heart rate, sleep disturbances, high blood pressure, muscle tension, decreased libido, early fatigue, different gastrointestinal disorders, obesity, diabetes, idiopathic diseases, atopic skin diseases (eczema, acne, etc.), psoriasis, delayed wound healing, menstruation problems of ladies, etc. are developed due to stress. Developments of various immunity-related, allergic, rheumatic, autoimmune, endocrine, neoplastic, and cardiovascular diseases are connected to different psychological stress components. Development of a self-care attitude, changing the surrounding environment to a favorable one, modification of lifestyle, practicing mind-controlling exercises like yoga and meditation, as well as taking assistance from any mental health professionals can be considered to counter or overcome psychological stress and staying away from different physical and mental health problems.

Keywords: Psychological stressors, Mental health, Physiology, Nervous system, Endocrine system, Immunity, Psoriasis, Cancers.

Human civilization proceeded along with the development of the brain, both in size and activities. The development of a very strong power of thinking is also associated with the development of high ambitions and frustrations. Failure to tackle the adversities of life can affect the power of thinking, and it creates a stressful condition in the mind, termed psychological stressors [1, 2, 3].

The term Psycho-Neuro-Immuno-Endocrinology (PNIE) was first described in 1936, though such effects of psychology on health have been noticed since ancient times and documented in different cultures. It covers the study of interactions between different psychological factors with physiological processes like neuronal, endocrine, and immune responses [1, 4, 5]. Thus, the subject deals with all four clinical areas together-psychology, nervous system, immunology, and endocrinology at various combinations and might be able to explore the root cause and developmental phenomenon of many disease conditions thought to be of unknown etiology so far [2, 4, 6].

Psychology is the study of mind and behavior and their interactions, nature of expression, etc. The altered functioning of the nervous system, either central or peripheral nervous systems or both, affects both the physical body and mind [2, 3, 7].

Immunology studies the development and functioning of the body's defense mechanisms against invaders. While hypo-functioning of one or a few body systems can make a person over-susceptible to

Editor, Exploratory Animal and Medical Research
**Corresponding author. e-mail: pattanayak1966@gmail.com*

infective agents, uncontrolled or over-activity of the system/s can also cause several serious disease conditions [2, 7]. The term Psychoneuroimmunology (PNI) describes the interactions between the emotional states, functions of the nervous system, and the immune system of an individual and the outcomes of such interactions [1, 7].

The subject 'endocrinology' deals with coordinated actions of different hormones on metabolism, energy production, growth, reproduction, stress, mood, etc., and various clinical conditions can arise due to altered secretion or functioning of the hormones [1, 3, 7].

The subject psycho-neuro-immuno-endocrinology deals with the identification of mechanisms of mind-body interactions [1, 2, 8] and the effects of one's mental states on physical health, but the reverse effects (effect of physical status on mental health) also happen equally [9]. The outcomes of different interactions of these four systems are studied part-by-part in the name of Neuropsychiatry (NP), Psycho-Neuro-Immunology (PNI), Immuno-Psychiatry (IP), etc. [1, 8, 10].

PSYCHOLOGICAL STRESSORS AND THE CREATION OF DISEASES

Role of different psychological and allied emotional factors on health

The physical and social environments surrounding a person can challenge one's ability to adapt and recover from different challenging situations. For adaptation to undesired circumstances, a balance between mental and emotional equilibrium is necessary; but the power or ability to do so differs between individuals based on factors like personal experiences, coping capabilities, flexibility level of the mind, power of adaptation, etc. Stressors may be of different natures - may be short-term or long-term. The long-term stressors like conflicts in the family, personal life, or workplace; the surrounding environment of an individual, health problems, discrimination feeling, social isolation, continued economic problems, etc. impact more on health than the acute stressors faced for a comparatively shorter period by any individual [11, 12].

Among the easily identifiable expressions of psychological stressors, anxiety feeling, confusion, depression, memory issues, problems in decision-making, attraction to negative thoughts, difficulty in focusing, lack of self-confidence, emotional disturbances, sudden change of mood, increased irritability, unhappiness, hopelessness, inability to relax, etc. are important [12, 13, 14].

The common physiological expressions of the effects of stress are headache, migraine, increased heart rate, sleep disturbances, high blood pressure, muscle tension, decreased libido, early fatigue, etc. [12, 15]. Development of different heart diseases, obesity, diabetes, idiopathic diseases, atopic skin diseases (eczema, acne, etc.), delayed wound healing, menstruation problems of ladies, cancers, etc. is commonly noticed in physical expressions of chronic stress [12, 13, 14]. Psychological stressors can induce or potentiate the symptoms of different gastrointestinal disorders, from simple indigestion to serious diseases like irritable bowel syndrome or inflammatory bowel disease [14, 15].

The PNIE provides an integrative framework to study complex interactions amongst neural, endocrine, and immune systems, as well as behavioral and psychosocial factors on the maintenance of healthy functioning, as well as the development and/or progression of illness. PNI has helped in the investigation of the pathophysiology of many diseases [8]. In addition, the level of different hormones in the body can influence other cells of the immune system, their secretions, as well as expression of the receptors of the hormones and also by creating resistance among them towards the hormones [16, 17].

People have their different psychological makeup and also have their own choices of different lifestyle-related factors. These include the food type, sleeping schedule, working schedule and style, physical exercise, use of narcotics, tobacco, alcohol, chemical drinks, processed foods, etc.; attachment to smartphones, having a nature-loving or nature detachment attitude, etc. All these factors act together and the ultimate mental and physical expressions are observed at the individual level. In another way, it can be said that by the overall outcome of the differences in the chain reactions of effects of all such factors, the psycho - neuro - immune - endocrine functions of the body are influenced and decide a large section of the physical and mental well-being of an individual [6, 18, 19].

The immunity system of the body can be influenced in different ways by psychological stressors. Effects of psychological stress on health following the interactions between the immune system and the brain are generally expressed slowly and so can be identified after a long time [13, 20]. Even the psychological stressors faced during childhood can affect the immune system in such a way that it can influence the development of the brain and its functioning in adulthood [13, 17, 21].

It is assumed from the experimental evidence that the actual root of many immunity-related, allergic, rheumatic, autoimmune, endocrine, neoplastic, and cardiovascular diseases are connected to different psychological components [1, 6, 13]. Neuropsychiatry (NP) is also related to diseases like epilepsy, hysteria, dementia, melancholia, psychosis, movement disorders, etc. [8, 10]. It is also assumed that even behind the development of severe mental disorders, environmental factors affecting psychology also play a role along with genetic predisposition [1, 10, 14].

A. Influence of psychological stressors on the nervous system and subsequent effects on health

The emotional state, mental condition, and attitude together play a very significant role in the functioning of different systems of the body including the nervous and immune systems [1, 13]. The main biological systems studied in PNI are the central and autonomic nervous system, neuro-endocrine systems, and immune system and their interactions. The central nervous system can recognize different experiences and can record them. The autonomic nervous system and the neuroendocrine systems are engaged in performing bodily functions and the immune system is involved in identifying and fighting against all the invaders in the body as well as eliminating the tumor cells. Normal functioning of all these systems by proper coordination with each other is necessary for the maintenance of good health, and any compromise at any of these steps can invite different diseases [8, 13].

B. Impact of psychological stressors on the immune system

Several pathways of interactions between the psychological state and immune system are already identified, but many such activities are still not clear. The strength and magnitude of the immunity system of the body is influenced by different psychological stressors. The psychological stress of a brief period can influence the Hypothalamic-Pituitary-Adrenal (HPA) axis and can influence the cellular immunity of the individuals negatively without showing any major impact on the humoral immunity, but chronic stress can influence both arms of the immunity system of the body [14, 22, 23].

Different studies have identified the mechanisms involved in these interactions involving human or animal models, from which the following conclusions may be drawn.

i) Psychological stressors can influence stressor-specific and time-dependent pattern of secretions from the cells of the central nervous system.

ii) Depending upon the individual, mutual, and antagonistic interactions between different hormone receptors (such as glucocorticoid and estrogen receptors), the inflammation-related genes can show expression profiles unique to the genders.

iii) Repeated social defeats can incur adverse experiences which can lead to the initiation of a few major neuro-immune actions after the migration of immune cells from the bone marrow to the brain.

iv) Exposure to any inflammatory stimulus or stress in early life affects the nervous, endocrine, and immunity systems of the body and their effects can be observed even in the later part of life [24, 25].

vi) The immune system is influenced by stressors through the PNIE pathway and the HPA axis via secretion of cortisol, catecholamine (epinephrine and norepinephrine), gamma interferon (from T lymphocytes), etc. [1, 6].

vi) Due to various activities of the pro-inflammatory cytokines (such as Tumor Necrosis Factors, Interleukin 1, 6, 8, etc.) and the tissue-damaging response of the cells involved in the cellular immunity of the body, systemic damage is performed.

vii) Decreased production of Tumor Necrosis Factor α (TNF-α) by the antigen-presenting cells (macrophages, dendritic cells, some B cells, etc.) and promotion of the T helper 2 (Th2) immune response (via secretion of some cytokines like Interleukin 4, 5, 10, 13, etc.) by the hormones like cortisol or catecholamine try to halt acute immune response but favor development of the allergic diseases.

viii) Some epigenetic factors working on the PNIE axis do not favor any acute response to the stressors and open the way for chronic stress response [1,6,17].

ix) Many psychological stressors can increase the activity of the microglial cells of the brain [3, 6, 26].

x) Psychological stressors can show many important impacts related to susceptibility to many diseases. They can influence the response of the body to vaccines (impaired immunity development), reactivation of some latent infections (such as Herpesvirus), increasing susceptibility to some diseases (such as the suffering of the common cold), cancers, autoimmune diseases, etc. [6, 16, 25].

xi) The effects of food, lifestyle, and their impacts on different internal body parts and cellular organelles (like the gut, brain, mitochondria of the cells, etc.) are

possibly involved in the determination of the immunity status of the body as well as mood and behavior of any individual [25].

C. Influence of stressors on aging and susceptibility to diseases

The major body parameters influenced by the psycho-somatic and environmental conditions (internal and external to the body) are disease susceptibility and aging. Stress is a strong risk for the health and proper functioning of all the systems of the body. Above a limit exercised at the individual level, stress can cause serious harm both in the long term and short term. It has a direct relationship with the development of early aging and more susceptibility to different diseases [6, 25]. Easy vulnerability to microbial or parasitic infections or suffering of other health problems due to lower or improper immunity status of the body are two main important aspects in this regard [13, 14].

Stress can lead to the development of serious mental conditions like depression and anxiety of different levels, and can also lead to some unhealthy lifestyles, etc. It can also lead to many secondary physical conditions like excessive weight gain, development of obesity, etc., and such conditions can invite further health problems like atopic diseases [6, 17].

D. Epigenetic influence of the psychological stressors on expression of genetic predisposition

Epigenetics is the study of the effect of all non-genetic factors influencing one or more genetic traits of an individual. The epigenetic factors are generally involved in the regulation of expression of the genes through methylation, phosphorylation, or acetylation of the DNA molecules, but not by altering the sequence of the nucleotides [6, 9, 27]. Psychological stressors can invite inflammation and different epigenetic activities like oxidative stress (non or improper removal of free radicals), mitochondrial dysfunctions, etc. [28, 29]. Effects of stressors on DNA methylation pattern, DNA wrapping protein histones, functioning of the non-coding R.N.A. during synthesis of proteins, shortening of the length of telomere, gene silencing leading to the development of abnormal cells, status of the epigenetic clock, etc. are some important aspects which can influence the immunity, disease susceptibility as well as the overall health of the individuals [13, 28, 29].

E. Principal agents involved in the physical expression of psychological stresses

Many physiological agents are involved in the physical expression of psychological stresses. The neuro-endocrine mediators (adrenalin, noradrenalin, glucocorticoids, etc.), neurotransmitters and neuropeptides, different types of cytokines, etc. are the principal agents working in the process [7, 13, 30].

a) The stress hormones - adrenalin and noradrenalin

During responding to psychological stress, stress hormones like adrenalin and noradrenalin are released by the adrenal gland of the body. In response to these hormones, an instant rise in blood pressure, heart rate, and blood sugar level is observed. But for long-lasting or regular repetition of such conditions, serious impacts are observed on different body systems [1, 7].

b) Cytokines and chemokines

Cytokines, a specific type of small-sized proteins secreted by some cells of the immune system of the body, act as agents of communication. The chemokines are a subgroup of the cytokines that mainly engage in control of the movement of different immune cells. Both of these also perform different other vital functions of the body [7, 12]. The cytokines produced in response to the stressors are usually some pro-inflammatory cytokines. Generally, the body secretes such pro-inflammatory cytokines in response to some infections or some injury. These cytokines assist the body system in fighting against the invading microorganisms and also repairing the tissue damage caused by any injury. Hormones like adrenalin can bind with specific receptors of some cells and stimulate the production of such pro-inflammatory cytokines. The increased level of corticosteroids, catecholamine, and pro-inflammatory cytokines can lead to a state of immune suppression in the body that can affect the HPA axis and the Sympathetic-Adrenal-Medullary (SAM) axis and can influence the functioning of leukocytes, involution of the thymus and suppression of lymphopoiesis [1, 7, 8].

The effect of abnormal release of cytokines may be observed after a long time. It is found that even the experience of stressful events in childhood may cause the release of specific cytokines in adulthood leading to mental illness [7, 8]. In animal models, it was observed that the production of the type of cytokines is dependent on the type and nature of the stress [6, 7, 8].

c) Neurotransmitters

The neurotransmitters are some active messengers engaged in the work of transmission of signals from the nerve cells to the target cells (of muscle, glands, etc.) in the body. Acetylcholine, γ-aminobutyric acid

(GABA), glutamate, endorphins, dopamine, histamine, serotonin, etc. are the main neurotransmitters performing versatile functions like breathing, controlling mood, concentration, appetite, digestion, heart rate, sleep cycles, muscle movement, etc. in the body [7, 32].

d) Neuropeptides

The neuropeptides are short-chain amino acids released by the neurons and act as neurotransmitters. Their actions are comparatively long-lasting in comparison with the neurotransmitters. Over one hundred neuropeptides are identified in the human brain. They can modulate the activities of the co-released neurotransmitters in the strength of synaptic signaling. Acting as some peptide hormones, these can also influence physiological and psychological processes like feeding, sensation of pain, social behavior, reproduction, learning, memory, etc. They can also influence other different important bodily functions. Vasopressin, oxytocin, calcitonin, amylin, angiotensin, neurotensin, bradykinin, etc. are some well-known neuropeptides [14, 31, 33].

IMPORTANT PSYCHO-NEURO-IMMUNO-ENDOCRINOLOGICAL DISEASES

A. Psoriasis

Due to abnormal activity of a part of the immune system of the body, skin cells may multiply very quickly and can make patches of different types. The patches of the skin of different organs of the body become scaly and may cause inflammation or other problems in the organs like the nails or hair root of the scalp. In this chronic health problem, the central nervous system, psychological stressors, mental health, and the immune systems are intertwined. Release of some cytokines from the cells of the immunity system of the body is triggered by psychological stressors. The hypothalamus signals to the pituitary to produce more cortisol production. Then cortisol triggers the production of pro-inflammatory cytokines from the immune system of the body and all these work together with the specific genes of the body to stimulate the multiplication of the skin cells at some abnormally high rate. Along with psychological stressors, some other agents may act as epigenetic stimulants to cause psoriasis. It is noticed that some infections (like HIV infection, Streptococcal infection, etc.), some chemical medicines used to treat some heart diseases, mental health problems, malaria, etc.; vices like smoking, physical conditions like obesity, etc. can potentiate the disease. In reverse, psychological conditions like low self-esteem, anxiety, depression, feelings of increased stress, suicidal thoughts, etc. are observed among people having psoriasis [7, 34].

B. Systemic inflammation

Systemic inflammation may develop as an outcome of psychological stresses in different ways. Continued physiological effects like sleep disturbance, increased sleep duration, production of pro-inflammatory cytokines, etc. can lead to systemic inflammation and the creation or potentiation of different diseases [17, 35]. Chronic release of different chemo-mediators due to long-term stress can cause many serious health problems. Resistance among the receptors of some cells of the immune system against glucocorticoids develops due to such continuous, high-level exposure to glucocorticoids at the cellular level [17, 21, 35]. Evidence suggests that continuous exposure to stressors results in increased phagocytic activity among the microglial cells present in different regions of the brain including the hippocampus. All such effects become a base of development for many serious health problems [3, 26, 35].

C. Cardiovascular diseases

Psychological stressors can impact the cardiovascular system in different ways. They can change the function of the endothelial cells of the blood vessels and also can influence the chemotactic pattern of the cells. The acute stressors can lead to increased Natural Killer (NK) cell-mediated cytotoxicity, leukocytosis, and decreased response to mitogens [25]. Acute and chronic psychological stressors keep the body under an elevated level of pro-inflammatory cytokines, acute phase proteins, and many hemostatic factors. The pro-inflammatory cytokines can increase blood pressure and heart rate along with several other effects. The acute phase proteins and the hemostatic factors can assist in thrombus formation that may result in the development of myocardial infarction. So, all these factors have some crucial roles in the development of Coronary Artery Disease (CAD) and many other cardiac problems [7, 25].

D. Cancers

The effect of different psychological stressors in the initiation or progression of different types of cancers is studied as a part of a thorough search of etiologies acting behind that dangerous disease. However, in spite of extensive studies, many areas of the subject are still not clear [6, 36, 37]. Some important outcomes of the related research can be listed as the following:

a) Social isolation, fatigue, well-being, etc. are studied for probable links between psychological stressors and the development of cancers. It is postulated that the psychological factors can influence cancer progression [36, 37].

b) The relation between stress and the development of cancers is measured by the detection of the level of cancer biomarkers in many cases (as in chronic lymphocytic leukemia). Diagnosis of cancers at an early stage by detection of biomarkers is given much importance nowadays [8, 36, 43].

c) Psychological stressors can lead to cancer through the activities of the pro-inflammatory cytokines or via immunosuppression, generally identified by the biomarkers [36, 37].

d) It is believed that the psychological stress and the oxidative stress are correlated [38, 39, 40]. Increased levels of reactive oxygen species (like hydrogen peroxide, superoxide anions, etc.) were detected in many cancer cells and it is assumed to be related to cancer development and progression [39, 40].

e) Natural Killer (NK) cells have a significant role in the surveillance and elimination of cancer cells from the body. It is observed that stress can lead to a lowering of the NK cell activity and their response to interferon as well as diminish the proliferation of the lymphocytes [6, 41].

f) A telomere is a structure made of nucleic acids and proteins that stay at the end part of the chromosomes and protect the DNA of the chromosomes. Normally, the size of the telomere is reduced with age. Due to some epigenetic influences like chronic psychological stress, the length of the telomere is reduced abnormally. The shorter length of telomere is linked with the development of cancers [36, 42].

g) It was noted that women having a genetic risk factor for the development of cancer show abnormalities in their immune system in response to psychological stresses [7, 8].

h) A link between psychological stress and abnormality in the immune system was identified among women with cervical, ovarian, and breast cancer [6, 7].

i) Depression and stress may influence the progression of cancers, as a poorer survival rate was noticed among cancer patients having such feelings [7, 44].

j) The breast cancer patients who received stress management interference showed improvement in their immune function. That observation can be read reversely to understand the effect of removal of stress can improve the immunity status and possibility of cancer development [6, 14, 36].

MANAGEMENT OF PSYCHOLOGICAL STRESSES

Stresses of all nature and magnitude do not have only some negative impacts on health. Many people may develop higher levels of determination after feeling stress from some failure. But above a certain level, stress may influence life negatively, both physiologically and psychologically. Such levels vary between individuals and are dependent on many variables faced at the individual level [6, 8].To get relief from the stress and its detrimental effects, some principles may be followed:

a) Identification of the strategies to cope with the situation and development of a self-care attitude are the primary steps to follow to overcome psychological stresses [12, 14].

b) Recognition of erroneous behavior and attitude of the self and then approaching their modification can change the surrounding environment to a favorable one [45].

c) Mind-controlling practices like yoga and meditation can assist in overcoming stress [45].

d) Modification of lifestyle by correcting biological clock, increasing sleeping time, allowing time to self to engage in the favorite activities of entertainment, incurring more socialization attitude, passing time with friends and pets, staying in a natural environment away from electronic gazettes occasionally, lone walking in the morning and/or afternoon, etc. can improve the situation [12, 18, 19].

e) Taking assistance from any mental health professionals and intake of medicines to remove stress can be considered as the next option [12, 46, 47].

REQUIREMENT OF INTENSE STUDY OF THE SUBJECT

The effects of psychological stressors on the initiation and progression of diseases is a vast topic for research, which is, however, at the initial stages and many areas are not clearly understood till now.

The bearing of psychology directly on the development of a few diseases, called psychosomatic diseases, was known to the medical community. The effect of psychological stressors on the creation of a few more diseases is identified at the present time. However, there are ample possibilities to find a strong link between psychological stress felling and disease creation among individuals for many other diseases also.

There may be some indirect relation between stress and disease creation. A person, feeling separated from society, may have a strong chance of tobacco, alcohol,

or narcotic addiction. Such addictions may induce many other vices and ultimately can lead to many serious health or mental problems.

Further importance is warranted to identify the possible epigenetic influences of different lifestyle parameters (causing or assisting psychological stresses) on the initiation or progression of important diseases, specifically. The study of the positive influence of following a designed lifestyle with reduced chance of feeling stress on suppression of the genetic predisposition to the disease/s is another important area waiting for intense study.

As psychological stress can affect many systems of the body through the psycho-neuro-immuno-endocrine axis followed by the hypothalamus-pituitary-adrenal axis and by involving different receptors of cells of different organs, there are ample chances of the effect of it on creation, stimulation of genetic predisposition or potentiation of many other diseases, if not all.

CONCLUSION

Psychological stressors have enormous impacts on maintaining mental and physical equilibrium. They can affect the nervous, endocrine, and immune systems of the body to initiate or potentiate many mental and physical health problems and may lead to many diseases of a very serious nature. Identification of the effect of different individual types of psychological stresses on the individual genotype and their link with specific mental or physical health problems are to be exposed properly. Understanding the link between psychological stressors and the creation of different diseases can lead to finding some easy prevention and remedial strategies to combat different types of diseases.

REFERENCES

1. Murray MT, Nowicki J. Immune System Support. In: Pizzorno JE, Murray MT (Eds.), Textbook of Natural Medicine (5th edn.), Churchill Livingstone. 2020; 1009-1016.e2, DOI:10.1016/B978-0-323-43044-9.00136-9.

2. Slavich GM. Psychoneuroimmunology of stress and mental health. In: Harkness K, Hayden EP. (Eds.), The Oxford handbook of stress and mental health. 2019; Oxford University Press, New York, DOI:10.1093/oxfordhb/9780190681777.013.24.

3. Bower JE, Kuhlman KR. Psychoneuroimmunology: An introduction to immune-to-brain communication and its implications for clinical psychology. Annu Rev Clin Psychol. 2023; 19:331-359, DOI:10.1146/annurev-clinpsy-080621-045153.

4. Solomon GF. The development and history of psychoneuroimmunology, the link between religion and health: psychoneuroimmunology and the faith factor. Online Education, 2010; Oxford Academic, DOI:10.1093/acprof:oso/9780195143607.003.0003.

5. Zachariae R. Psychoneuroimmunology: a bio-psycho-social approach to health and disease. Scand J Psychol. 2009; 50(6):645-651, DOI:10.1111/j.1467-9450.2009.00779.x.

6. González-Díaz SN, Arias-Cruz A, Elizondo-Villarreal B, Monge-Ortega OP. Psychoneuroimmunoendocrinology: clinical implications. World Allergy Organizati J. 2017; 10:19, DOI:10.1186/s40413-017-0151-6.

7. Seladi-Schulman J. Understanding psychoneuroimmunology: What is psychoneuroimmunology? 2018; https://www.healthline.com/health/psychoneuroimmunology.

8. Jiménez JA, Mills PJ, Behavioral Medicine. In: Ramachandran VS (Ed.), Encyclopedia of Human Behavior (2nd edn.), 2012; 311-318. Academic Press, DOI:10.1016/B978-0-12-375000-6.00057-4.

9. Carroll K. Psychoneuroimmunology examples. 2023; https://study.com/academy/lesson/what-is-psychoneuroimmunology-definition-lesson.html.

10. Bechter K. Development of neuropsychiatry over the last 30 years and the new era of Immuno-psychiatry. J Affecti Disord Repo. 2023; 14, DOI:10.1016/j.jadr.2023.100656.

11. Monroe SM, Slavich GM. Psychological stressors: Overview. In: Fink G (Ed), Stress: Concepts, Cognition, Emotion, and Behavior, Academic Press, 2016; 109-115, DOI:10.1016/B978-0-12-800951-2.00013-3.

12. Yarp A. Signs of psychological stress: What causes it and how to manage it. 2024; https://www.verywellhealth.com/psychological-stress-5205714.

13. Polsky LR, Rentscher KE, Carroll JE. Stress-induced biological aging: A review and guide for research priorities. Brain Behavior, Immunity. 2022; 104:97-109.

14. Newman T . Psychoneuroimmunology: laugh and be well. 2016; https://www.medicalnewstoday.com/articles/305921.

15. Berry JKM, Drummond PD. Psychological generators of stress-headaches. J Behav Med. 2018; 41(1):109-121, DOI:10.1007/s10865-017-9872-9.

16. Glaser R. Stress-associated immune dysregulation and its importance for human health: A personal history of psychoneuroimmunology. Brain Behavior Immunity. 2005; 19(1):3-11.

17. O'Connor MF, Bower JE, Cho HJ, *et al.* To assess, to control, to exclude: Effects of biobehavioral factors on circulating inflammatory markers. Brain Behavior Immunity. 2009; 23(7):887-897.

18. Pattanayak S. Anti-cancer plants and their therapeutic use as succulent biomedicine capsules. Explor Anim Med Res. 2023; 13(Ethnomed. Spl.), DOI:10.52635/eamr/13(S)01-50.

19. Kesebir P, Kesebir S. How modern life became disconnected from nature. 2017; https://greatergood.berkeley.edu/article/item/how_modern_life_became_disconnected_from_nature.

20. Miller GE, Cohen S, Ritchey AK. Chronic psychological stress and the regulation of pro-inflammatory cytokines: A glucocorticoid-resistance model. Health Psychology. 2002; 21(6):531-541.

21. Danese A, Lewis SJ. Psychoneuroimmunology of early-life stress: The hidden wounds of childhood trauma? Neuropsychopharmacol Rev. 2017; 42:99-114, DOI:10.1038/npp.2016.198.

22. Segerstrom SC, Miller GE. Psychological stress and the human immune system: A meta-analytic study of 30 years of inquiry. Psychologic Bullet. 2004;130(4):601-630.

23. Marshall Jr. GD, The adverse effects of psychological stress on immunoregulatory balance: Applications to human inflammatory diseases. Immunol Allergy Clin North Am. 2011; 31(1):133-140, DOI:10.1016/j.iac.2010.09.013.

24. Ho RCM, Neo LF, Chua ANC, Cheak AAC, Mak A, Research on psychoneuroimmunology: Does stress influence immunity and cause coronary artery disease? Ann Acad Med Singapore. 2010; 39(3):191-196.

25. Chen MA, Fagundes CP. Psychoneuroimmunology. 2023; DOI:10.1093/obo/9780199828340-0303. https://www.oxfordbibliographies.com/display/document/obo-9780199828340/obo-9780199828340-0303.xml.

26. Calcia MA, Bonsall DR, Bloomfield PS, Selvaraj S, Barichello T, Howes OD. Stress and neuroinflammation: a systematic review of the effects of stress on microglia and the implications for mental illness. Psychopharmacology. 2016; 233:1637-1650, DOI:10.1007/s00213-016-4218-9.

27. Zannas AS. Epigenetics as a key link between psychosocial stress and aging: concepts, evidence, mechanisms. Dialogues Clin Neurosci. 2019: 21(4):389-396, DOI:10.31887/DCNS.2019.21.4/azannas.

28. deNadal E, Ammerer G, Posas F. Controlling gene expression in response to stress. Nat Rev Genet. 2011; 12:833-845, DOI:10.1038/nrg3055.

29. Pattanayak S. Biological age and lifestyle: key deciding factors of aging and disease susceptibility. Explor Anim Med Res. 2024; 14(1), DOI:10.52635/eamr/14.1.1-5.

30. Horvath S, Raj K. DNA methylation-based biomarkers and the epigenetic clock theory of ageing. Nat Rev Genet. 2018; 19(6):371-384, DOI:10.1038/s41576-018-0004-3.

31. Méndez-Couz M, Manahan-Vaughan D, Silva AP, González-Pardo H, Arias JL, Conejo NM. Metaplastic contribution of neuropeptide Y receptors to spatial memory acquisition. Behavioural Brain Res. 2021; 396:112864, DOI:10.1016/j.bbr.2020.112864.

32. Berry J. What are neurotransmitters? https://www.medicalnewstoday.com/articles/326649.

33. Russo AF. Overview of neuropeptides: Awakening the senses? Headache. 2017; 57(Suppl 2):37-46, DOI:10.1111/head.13084.

34. Psoriasis. National Institute of Arthritis and Musculoskeletal and Skin Diseases (An official website of the United States government), https://www.niams.nih.gov/health-topics/psoriasis. Accessed on 26.10.2024.

35. Irwin MR, Olmstead R, Carroll JE. Sleep disturbance, sleep duration, and inflammation: A systematic review and meta-analysis of cohort studies and experimental sleep deprivation. 2016; 80(1):40-52, DOI:10.1016/j.biopsych.2015.05.014.

36. Cheng L, Meiser B. The relationship between psychosocial factors and biomarkers in cancer patients: A systematic review of the literature. European J Oncology Nursing, 2019; 41:88-96, DOI:10.1016/j.ejon.2019.06.002.

37. Meiser-Stedman R, McKinnon A, Dixon C, Boyle A, Smith P, Dalgleish T. A core role for cognitive processes in the acute onset and maintenance of post-traumatic stress in children and adolescents. J Child Psychol Psychiat, 60(8), 2019; 875-884, DOI:10.1111/jcpp.13054.

38. Salim S. Oxidative stress and psychological disorders. Curr Neuropharmacol. 2014; 12(2):140-147, DOI:10.2174/1570159X11666131120230309.

39. Kim E, Zhao Z, Rzasa JR, Glassman M, Bentley WE, *et al*. Association of acute psychosocial stress with oxidative stress: Evidence from serum analysis. Redox Biol. 2021; 47:102138, DOI:10.1016/j.redox.2021.102138.

40. Bayer JL, Spitz DR, Christensen D, McCormick ML, Farley D, *et al*. Biobehavioral and neuroendocrine correlates of antioxidant enzyme activity in ovarian carcinoma. Brain Behavior Immunity, 2015; 50:58-62, DOI:10.1016/j.bbi.2015.04.019.

41. Witek-Janusek L, Gabram S, Mathews HL. Psychologic stress, reduced NK cell activity, and cytokine dys-regulation in women experiencing diagnostic breast biopsy. Psychoneuroendocrinology. 2007; 32(1):22-35, DOI:10.1016/j.psyneuen.2006.09.011.

42. Okamoto K, Seimiya H. Revisiting telomere shortening in cancer. Cells. 2019; 8(2):107, DOI:10.3390/cells8020107.

43. National Cancer Institute. Biomarker Testing for Cancer Treatment. https://www.cancer.gov/about-cancer/treatment/types/biomarker-testing-cancer-treatmentBiomarker. Accessed on 22.10.2024.

44. McDonald PG, O'Connell M, Lutgendorf SK. Psychoneuroimmunology and cancer: A decade of discovery, paradigm shifts, and methodological innovations. Brain Behav Immun. 2013; 30:S1-S9, DOI:10.1016/j.bbi.2013.01.003.

45. Reza T, Grezenko H, Barker C, Bakht D, Faran N, *et al.* Emotional stress and immune response in surgery: A psychoneuroimmunological perspective. Cureus. 2023; 15(11):e48727, DOI:10.7759/cureus.48727.

46. Deak T, Matt Quinn M, Cidlowski JA, Victoria NC, Murphy AZ, Sheridan JF. Neuroimmune mechanisms of stress: sex differences, developmental plasticity, and implications for pharmacotherapy of stress-related disease. Stress. 2015; 18(4):367-380, DOI:10.3109/10253890.2015.1053451.

47. Mills KL, Lalonde F, Clasen LS, Giedd JN, Blakemore SJ. Developmental changes in the structure of social brain in late childhood and adolescence. Soc Cogn Affect Neurosci. 2014; 9(1):123-131, DOI:10.1093/scan/nss 113.

Cite this article as: Pattanayak S. Psycho-neuro-immuno-endocrinology: study of the key factors of disease creation. Explor Anim Med Res. 2024; 14(2), DOI:10.52635/eamr/14.2.164-171.

Explor Anim Med Res.
Vol. 14, Issue 1, 2024
DOI: 10.52635/eamr/14.1.1-5

ISSN 2277-470X (Print), ISSN 2319-247X (Online)
Website: www.animalmedicalresearch.org

Published under the CC BY-NC 4.0 license

Editorial

BIOLOGICAL AGE AND LIFESTYLE: KEY DECIDING FACTORS OF AGING AND DISEASE SUSCEPTIBILITY

Shibabrata Pattanayak*

ABSTRACT: The biological age of an individual depends mainly on the genetic status and different epigenetic influences experienced by the individual and it has a direct relationship with aging and suffering from different diseases. It can be understood from the observable physiological parameters like the level of specific health indicators in the body, status of vision and hearing, condition of joints, immunity, nutritional status, presence of inflammatory markers and certain proteins in the blood, etc. Determining factors of biological age include the level of oxidative stress, glycation pattern of the DNA, protein, and lipid; different epigenetic factors, etc. The main genetic biomarkers of biological aging are the length of the telomeres, DNA methylation pattern, and the status of the epigenetic clock of an individual. The epigenetic and other related factors causing early aging and more susceptibility towards gene-related or unrelated diseases can be prevented and reversed by the exclusion of the detrimental practices from the lifestyle along with the inclusion of some positive factors. Lifestyle and nutrigenetics are the subjects engaged in the related study. The 'unique disease principle' describes diseases as an outcome of the disease reasons and environmental conditions (including health status) at the individual level. The microbiome profile and individual immunity status are given importance for the selection of ways to combat diseases in the Molecular Pathological Epidemiology (MPE). A specific diet plan, the DIP diet, is advocated along with following a designed lifestyle and getting assistance with some disease-specific physical measures for combating lifestyle diseases. The succulent parts of the effective medicinal plants are recommended for their direct therapeutic use in unaltered conditions in the form of bio-capsules prepared without the addition of any materials of synthetic origin along with following a designed lifestyle is another branch of research related to the topic.

Keywords: Aging biomarkers, DNA methylation, Length of telomeres, Epigenetic clock, Nutrigenetics, Microbiome, Molecular pathological epidemiology, DIP diet, Succulent biomedicine.

INTRODUCTION

The chronological age is calculated from the birth. It is considered everywhere as important, but not considered so important in the contemporary research of aging and disease susceptibility. For such effects, the biological age is only considered important. The biological age expresses the actual condition of the body at its cellular level and it does not depend completely on the genetics of the individuals. Many physiological, biological, and environmental factors work together from behind to determine the biological age of an individual. Genetic predispositions for the disease/s are also controlled by many such biological factors from behind before actual expression of these to any clinical disease [1, 2]. As per some recent research, the actual health status, aging, and susceptibility to various diseases are all dependent on biological age, environmental conditions along with past and present lifestyle of an individual - not only on the chronological age. The factors like intake of different components in the name of food, drink, healthcare assistance, cosmetics, etc., and their actual

Editor, Exploratory Animal and Medical Research
**Corresponding author. e-mail: pattanayak1966@gmail.com*

long-term cumulative effects, and other factors like physical exercise, stress, body clock maintenance, quality of breathing air and physical environment is not less important than the genotype of an individual [3,4].

BIOLOGICAL AGE AND AGING BIOMARKERS

Twelve influencing subjects of aging are listed by the Max Planck Institute for Biology of Ageing. These are genetic instability, degradation of the telomere, epigenetic changes, loss of proteostasis, impaired perception of nutrients, dysfunction of the mitochondria, cellular senescence, exhaustion of the stem cells, altered intercellular communication, deteriorated autophagy, chronic inflammation, and imbalance of the intestinal flora [www.age.mpg.de/how-do-we-age]. Along with chronological age, oxidative stress, glycation patterns of DNA, protein and lipids, and genetic status are also considered as the causative factors for aging by Cawthon (2016) [5]. The subject is analyzed differently by other authors.

A. Physiological biomarkers

It is noticed that even the homozygous twins who live in different environments and follow different lifestyles may have differences in aging parameters [6, 7]. The term biological age denotes the actual current status of the body. It is determined by analyzing some biomarkers in the present stage of research. These aging biomarkers are practically some characteristics that influence some predictions to determine the actual functional state of the body system. These include observable physical parameters like blood pressure, level of cholesterol, the status of vision and hearing, mobility stage of joints, nutritional status, immunity status, different inflammatory markers, and certain proteins in the blood, etc. - as all of these parameters generally show the overall deterioration of the systems along with the increase of age [2, 8, 9]. Two determining factors of such biomarkers are stated below.

i. Oxidative stress

During aerobic metabolism, single-atom oxygen develops, called free radicals, and has scavenging activities. These, if not managed by a supply of sufficient antioxidants, can damage different biomolecules of the body including DNA by acting as Reactive Oxygen Species [10].

ii. Glycation

Due to certain reasons, the glucose molecules bind with some DNA, protein, and lipid molecules of our body. Such binding can hamper the normal functioning of these molecules inside the body. Later, the concerned tissues fail to function properly, leading to early aging, more prone to various diseases and early death [5].

B. Epigenetics and genetic biomarkers

The subject 'epigenetics' deals with the environmental influences on the genes for its expression and proper working. The negative effects of epigenetic changes are generally reversible and generally do not cause any change in the DNA sequence, though the reading of the DNA sequences in the body system can be influenced by such changes. DNA methylation, modification pattern of the DNA wrapping protein histones, and control of the activities of non-coding RNA to decide the synthesis of the proteins in the cells are the three main parts of epigenetics [www.cdc.gov/genomics/disease/epigenetics.htm].

It is observed that the genetic factors behind the risk of developing disease and aging are much more active in the younger age and the non-genetic factors play a very strong role in the latter stage of life. The late-age expressible genes have a higher chance of synthesis of abnormal or defective proteins than the early-age expressible genes [11, www.age.mpg.de/211116/what-is-biological-age].

Among the genetic biomarkers of biological aging, the length of the telomeres, DNA methylation pattern, and epigenetic clock are considered the most important.

i. Length of the telomeres

The chromosomes are made up of nucleotides. At the tail portion of the chromosomes, a long set of nucleotides are set. These nucleotides do not take an active part during the cell division. A portion of them are deleted during every phase of cell division, so the chromosomes become shorter every time. These extra nucleotides are termed as telomeres. The presence of the number of telomere nucleotides is controlled by the enzymatic activities of the cell. It is assumed that the reduction rate of the telomere nucleotide and the consequent rate of reduction of the size of the chromosomes are also influenced by many other non-genetic factors (such as lifestyle). A very high or abnormal shortening of telomere size can induce improper activities of the chromosome (short telomere syndrome - STS) leading to mutations and then the creation of many dangerous diseases.

Due to shortened telomere, the cells may die early and invite many diseases of infectious or non-infectious origin leading to early aging and early death of the

individual. Shortened telomere may cause many other important diseases other than early aging, like different neuro-degenerative disorders, etc. [4, 12]. In such an extreme condition, if the cells are compelled to synthesize more and more telomerase enzymes to increase the number of telomere nucleotides in the chromosome and prevent telomeres from becoming shorter, different cancers develop. These include cancers of the bone, pancreas, lung, prostate, kidney, bladder, neck head, etc. [5, https://dralexisshields.com/biological-age].

ii. DNA methylation pattern

Among the estimated 30000 genes of humans, instructions to carry out individual activities properly may not be performed each time by every one of them. The body has different control procedures over the entire system. But during working continuously, as a normal happening, methylation of the DNA molecules happens. However, the pattern of DNA methylation varies among individuals as per their lifestyle and other factors, like rusting in the iron kept in different environments. DNA methylation can control the expression of genes in many cases.

Examination of DNA methylation pattern is a part of the epigenetic study - the study of the expression of genes based on the lifestyle and the surrounding environment. As the DNA methylation pattern varies among people with different lifestyles, it may be an indicator of the influence of lifestyle on the biological age of an individual. Increased methylation of DNA can disrupt the normal functioning of the organ or body as they can fail to perform the work efficiently for which they are engaged [https://dralexisshields.com/biological-age].

iii. Epigenetic clock

The epigenetic clock is a hypothetical clock to measure the biological age of an individual, determined by analyzing the results of some specific biochemical tests. The tests are used mainly to know the level of DNA methylation of the individuals and calculate the methyl groups accumulated in the DNA molecules [13, https://dralexisshields.com/biological-age].

BIOLOGICAL AGE AND DISEASE

Disease susceptibility is influenced by the biological age. Early aging always brings more susceptibility to different diseases. Many diseases have the root of the genetic predisposition of an individual towards the disease. However, this is not a complete concept, as various epigenetic factors also work in this process. The genetic predisposition generally cannot cause the disease unless they are triggered. The triggering factors include following of wrong lifestyle and negative effects on the inner (inside the body) and surrounding outer environment of the individuals. There is a requirement to switch on one or a few triggering factors for the initiation of a disease. But the list of the triggering factors behind the diseases, particularly behind the so-called lifestyle diseases, may be very large in number and there may be cumulative activity of such factors behind such diseases. Our contemporary knowledge cannot supply us with any clear picture of such different switches diseases specifically, but such factors definitely work behind the stimulation of predisposing genetic conditions, or even maybe for non predisposing diseases in the way of expression as a disease. The wrong diet, lack of physical exercise, low production of Vitamin D by sunlight exposure, etc. added by habits like tobacco, alcohol, or narcotic drug intake, etc. can be the driving force for the expression of such diseases. Type 2 diabetes and other metabolic diseases, different cardiovascular diseases, lung diseases (from chronic bronchitis to pulmonary fibrosis), cancers, dementia, Alzheimer's disease, etc. may be considered as some examples [12, 14].

REVERSION OF THE BIOLOGICAL AGE

i. Lifestyle modification

The epigenetic and other factors switching various diseases and inviting early aging can be controlled. In many cases, the ugly condition of the health can be revised. The early the initiatives taken the better will be the achievement. Control of the surrounding environment is not always under the control of an individual, but the lifestyle is always under control. A detailed list of the common harmful practices in the lifestyle and their possible modification for better health is discussed in some articles. Grossly, exclusion of all processed foods, chemical or chemical-added food, and drinks, chemical-added healthcare materials, etc., and inclusion of naturally available food (in the form of vegetable salad, seed, and nut salad, fruit salad, etc. as well as eating of food prepared by nature-derived ingredients only following simple procedures of cooking), nature-derived drinks (green coconut to lemon water), nature gifted healthcare materials, etc. at unaltered state, imposing restrictions in the lifestyle like maintenance of body clock, the addition of natural forces like regular sunlight exposure to the skin, loan walking, etc. and practicing mental

refresher techniques like meditation, etc. in the lifestyle is advocated in these articles [3, 4]. Efforts are made to uncover mechanisms behind positive effects on health due to such modification of the lifestyle-related factors attempted in some other articles [14, 15, https://dralexisshields.com/biological-age].

ii. Nutrigenetics-the gene-nutrient interaction theory

According to this theory, the expression of the genetic predisposition is dependent on the availability or non-availability of proper nutrients inside the body system. Apart from the main nutrients like carbohydrates, protein, and fats, different micronutrients as well as different anti-oxidants of the diet are required in the body's system to keep it healthy. Personalized nutrients based on individual genetics are proposed in this system. The association and interaction of genes and nutrients have been already identified in many lifestyle-associated diseases and that creates the base of that theory [16].

Studies suggest that maintaining or adopting a healthy lifestyle can reverse the effect of short telomere syndrome and associated complexities [4] and also can cause reversion of the negative effects of unhealthy DNA methylation patterns [12, 13].

CHIEF HEALTHCARE CONSIDERATIONS IDENTIFIED

Many types of research are going on for the identification of different aspects of healthcare depending upon the genotype, lifestyle, and the surrounding environment of an individual. Among them, three major aspects can be short-listed.

i. Molecular pathological epidemiology (MPE)

It is a proposed system of considering the outcome of a clinical disease as the final result of different molecular alterations within the cells as well as their microenvironment, influenced by various exogenous and endogenous factors. It considers heterogeneity among different individuals in pathology and pathophysiology at the molecular level. Based on "the unique disease principle", a disease incidence and/ or mortality is thought to be an outcome of the interaction between the disease subtypes and the specific environmental exposure at the individual level. So, there should be accurate medicine/ preventive procedures for the prevention and treatment of any disease as per the personalized status of an individual. The immunity status and the microbiome profile of the host are given importance in this system for the selection of procedures to combat a disease.

Research directed with several interdisciplinary areas (such as pharmaco-MPE, Microbial-MPE, Immuno-MPE, etc.) has already started to identify the actual etiologic mechanisms behind a clinical disease at the individual level. That approach can calculate disease-specific risk estimates leading to genome-wise disease possibility pattern studies on public health [17, 18, 19].

ii. Following the disciplined and intelligent people diet (D.I.P diet) plan

This diet plan includes mainly plant-based ingredients. Some specific protocols are there for their dietary use at different times of the day. Fruits, nuts, etc. are advocated for dietary use in their raw form, not in any processed form. As per that branch of health research, diseases like high blood pressure, thyroid problems, diabetes, arthritis, kidney problems, cancers, liver diseases, obesity, etc. can be prevented and even reversed by following a reversion of lifestyle towards a specific direction, taking help of some disease-specific physical measures and following that particular diet plan [20, 21].

iii. Use of succulent biomedicine capsules for combating diseases

Along with following a designed lifestyle, parts of the effective medicinal plants in their unaltered state can directly be used in healthcare. These can be used as general immune-modulators or disease-specific preventive as well as curative biomedicines. The succulent parts of effective medicinal plants can be encapsulated following some specific procedures and then preserved and transported globally for different healthcare purposes. The addition of any synthetic chemicals or materials in any name or form is not permitted for use in the preparation of these biomedicines and some specific cold chain transportation is advocated with some specifically designed systems [3, 22, 23].

CONCLUSION

Aging and disease susceptibility depends on the biological age of an individual. The genetic predisposition of an individual is triggered by epigenetic factors like wrong lifestyle habits to cause diseases. Many biomarkers are identified to understand the biological age of the individuals. Prevention and reversion of aging speed and disease condition are

studied under umbrellas like nutrigenetics, Molecular pathological epidemiology, DIP diet plan, and therapeutic use of Succulent biomedicine capsules. In all these branches of study, modification of lifestyle is considered a precondition. Further thorough study is needed for efficient application of these proposed systems, singly or together.

REFERENCES

1. Kuo CL, Luke C. Pilling LC, Zuyun Liu Z, Janice L *et al.* Genetic associations for two biological age measures point to distinct aging phenotypes. Aging Cell. 2021; 20(e13376): 1-17, https://doi.org/10.1111/acel.13376.

2. Frothingham S, Lee J. Chronological aging and biological aging. 2023; https://www.healthline.com/health/chronological-ageing, accessed on 12.03.2024.

3. Pattanayak S. Anti-cancer plants and their therapeutic use as succulent biomedicine capsules. Explor Anim Med Res. 2023; 13(Ethnomed. Spl.), DOI: 10.52635/eamr/13(S)01-50.

4. Basaraba S. Chronological vs. biological age. 2023; https://www.verywellhealth.com/what-is-chronological-age, accessed on 14.03.2024.

5. Cawthon R. Genetic Science Learning Center. Are telomeres the key to aging and cancer. Learn Genetics. 2016; https://learn.genetics.utah.edu/content/basics/telomeres, accessed on 03.03. 2024.

6. Fraga MF, Ballestar E, Paz MF, Ropero S, Setien F *et al.* Epigenetic differences arise during the lifetime of monozygotic twins. Proc Natl Acad Sci USA. 2005; 102(30): 10604-10609, DOI: 10.1073/pnas.0500398102.

7. Hagenbeek FA, Hirzinger JS, Breunig S, Bruins S, Kuznetsov DV *et al.* Maximizing the value of twin studies in health and behaviour. Nat Hum Behav. 2023; 7: 849-860, https://doi.org/10.1038/s41562-023-01609-6.

8. Jylhävä J, Pedersen NL, Hägg S. Biological age predictors. E Bio Medic. 2017; 21: 29-36, DOI: 10.1016/j.ebiom.2017.03.046.

9. Jazwinski SM, Kim S. Examination of the dimensions of biological age. Front Genet. 2019; 10: 263, DOI: 10.3389/fgene.2019.00263.

10. Pattanayak S. Anti-COVID-19 biomedicines - a layout proposal for production, storage and transportation. The Open Covid J. 2021; 1: 166-188, DOI: 10.2174/2666958702101010166.

11. Jiang X, Holmes C, McVean G. The impact of age on genetic risk for common diseases. PLoS Genet. 2021; 17(8): e1009723, https://doi.org/10.1371/journal.pgen.100 9723.

12. Vaughan DE. What is your actual age? The Science of Longevity. 2022; https://www.nm.org/healthbeat/medical-advances/science-and-research/What-is-Your-Actual-Age.

13. Horvath S, Raj K. DNA methylation-based biomarkers and the epigenetic clock theory of ageing. Nat Rev Genet. 2018; 19(6): 371-384, DOI: 10.1038/s41576-018-0004-3.

14. Brody B. Genes vs. lifestyle: which matters more for health? 2022; https://www.webmd.com/healthy-aging/features/genes-or-lifestyle.

15. Pattanayak S. Succulent biomedicines - an effective way of getting protection against diseases through immunomodulation. Explor Anim Med Res. 2020; 10(2): 112-123.

16. Beckett EL, Jones PR, Veysey M, Lucock M. Nutrigenetics - personalized nutrition in the genetic age. Explor Res Hypothes Medic 2017; 2(4): 109-116, DOI: 10.14218/ERHM.2017.00027.

17. Nishihara R, VanderWeele TJ, Shibuya K, Mittleman MA, Wang M *et al.* Molecular pathological epidemiology gives clues to paradoxical findings. Eur J Epidemiol. 2015; 30(10): 1129-1135, DOI: 10.1007/s10654-015-0088-4.

18. Hamada T, Keum N, Nishihara R, Ogino S. Molecular pathological epidemiology: new developing frontiers of big data science to study etiologies and pathogenesis. J Gastroenterol. 2017; 52(3): 265-275, DOI: 10.1007/s00535-016-1272-3.

19. Dai J, Nishi A, Tran N, Yamamoto Y, Dewey G *et al.* Revisiting social MPE: an integration of molecular pathological epidemiology and social science in the new era of precision medicine, Expert Rev Molecul Diagnosti. 2021; 21(9): 869-886, DOI: 10.1080/14737159.2021.1952073.

20. Roy Chowdhury B. Diabetes reversal by plant-based diet. J Metabolic Synd. 2017; 6(4): 1000232. DOI: 10.4172/2167-0943.1000232.

21. Roy Chowdhury B. DIP diet plan. 2021; https://dipdiet.in/wp-content/uploads/2021/06/Dip-Diet-Plan-1.pdf, accessed on 12. 03. 2022.

22. Pattanayak S. Healthcare system using succulent parts of plants, Volume I: For infectious diseases. 2019; ISBN: 978-93-5346-842-2.

23. Pattanayak S. Healthcare system using succulent parts of plants, Volume II: Steps for production and marketing of some selected healthcare products. 2019; ISBN: 978-93-5391-625-1.

Cite this article as: Pattanayak S. Biological age and lifestyle: key deciding factors of aging and disease susceptibility. Explor Anim Med Res. 2024; 14(1), DOI: 10.52635/eamr/14.1.1-5.

Explor Anim Med Res.
Vol. 13, Issue 2, 2023
DOI: 10.52635/eamr/13.2.140-145

ISSN 2277-470X (Print), ISSN 2319-247X (Online)
Website: www.animalmedicalresearch.org

Published under the CC BY-NC 4.0 license

Editorial

LIMITATIONS OF THE CONTEMPORARY VACCINES: HOW TO OVERCOME ?

Shibabrata Pattanayak*

ABSTRACT: Vaccines are used generally to prevent a few infectious diseases by stimulating the weapons of acquired immunity of the body against specific antigens. Along with desired antigens or their source, many other assisting materials are added to the vaccines. There are reports of failure of vaccination as well as of some instant side effects possibly due to the ingredients used in the vaccines. Many important infectious diseases are not covered by vaccination due to various reasons. The non-specific immunity power of the body can be modulated to prevent both infectious diseases as well as diseases of other origins. Following a designed lifestyle and intake of succulent biomedicines can be the two arms for achieving the target. The succulent biomedicines can also supply different important micronutrients and neutraceuticals to the body and also can incur many positive effects on different body systems by the activities of the phyto-constituents individually, as well as through their combinational effects.

Keywords: : Acquired immunity, Vaccination, Limitation, Innate immunity, Succulent biomedicines, Lifestyle modification.

Vaccines are produced artificially and used to initiate or strengthen the immune response against diseases in the body. So, these can assist in developing specific immunity against some specific pathogens. Most of the vaccines are used as an injectable item for apparently healthy humans or animals and only a few are advocated for oral intake. The majority of vaccines require repetition after a few months or years to develop or to keep the protective immunity power of the body at the level of prevention of diseases. Vaccinations mimic the natural way for the development of active immunity against any disease-producing organism following the recovery from clinical or subclinical infection of the organism [1, 2].

The development of protective antibodies against the disease of interest inside the body is the main target of vaccination. These antibodies can act against the specific disease-producing organisms (or proteins in some cases) in the body. So, generally, vaccination is performed for disease specifically, and thus vaccination against one disease cannot protect the vaccinated individuals from other diseases. A large portion of human diseases (60-75%) are derived from non-human species (zoonotic spillover) and the trend shows that the deaths due to such diseases may increase 12 times in 2050 in comparison to 2020 [3, 4]. So, the scope of prevention of infection of various types of disease-producing organisms (maybe a few thousand) is not possible by performing vaccination against all of them.

Along with that limitation, there may be some other undesirable effects of the presently used vaccines. Various parameters of contemporary vaccines are discussed and a possible adjunct or alternate way of vaccination to strengthen the disease-preventive power of the body is searched out in this article.

CONTEMPORARY VACCINES: TYPE AND COMPOSITION

A. Types of vaccine

The main types of vaccines currently in use are inactivated vaccines, live-attenuated vaccines, mRNA vaccines, recombinant vaccines, subunit vaccines, conjugate vaccines, polysaccharide vaccines, viral vector vaccines, and toxoid vaccines [1, 5, 6].

Editor, Exploratory Animal and Medical Research.
**Corresponding author. e-mail: pattanayak1966@gmail.com*

B. Composition of vaccines

Along with antigens or resources capable of supplying antigens, many other materials are added during the preparation of a vaccine. The addition of such chemicals varies from vaccine to vaccine. A description of some of such components is available in the literature.

1. Active component - the antigen or materials supplying antigen.

These may be of different types, like attenuated live viruses, inactivated viruses or bacterium, part of the virus or bacterium, part of toxin produced by the bacterium, etc.

2. Adjuvant: These chemicals are added to the vaccines to enhance the immune response of the body to the vaccine antigen. Various aluminum salts [as aluminum hydroxide, aluminum phosphate, potassium aluminum sulfate (alum), etc.] are commonly used for that purpose. Other materials, like oil in emulsion (as MF 59, AF03, or AS03 using squalene) [7], part of other organisms (as AS04 contains modified molecules from the *Salmonella minnesota* bacterium) [8], etc. are examples.

3. Stabilizers: Sugars like sucrose and lactose, amino acid glycine, monosodium glutamate, serum or recombinant albumin (bovine or human origin), gelatin (partially hydrolyzed collagen of porcine or bovine origin), etc.

4. Preservatives: Thiomersal (a mercury-containing compound), 2-phenoxyethanol (aromatic ether alcohol), phenol (carbolic acid), etc.

5. Buffers: Buffers are used to control the changes in pH, maintain osmolarity and adjust tonicity. Sodium chloride is used generally for that purpose.

6. Surfactants: These are used to keep particles suspended in liquid vaccines by preventing settling or clumping by reducing the surface tension of the vaccine liquid. Examples are - polysorbate 80 (prepared from sorbitol), oleic acid (omega-9 fatty acid), etc.

7. Solvent: Distilled water is generally used for that purpose.

8. Trace components: Cell culture media fluids and components, egg proteins, yeast, antibiotics (such as Neomycin, Kanamycin, Streptomycin, etc.), inactivating agents (such as formaldehyde), etc. [9, 10].

So, as per the available literature, it appears that we get many compounds of synthetic or semi-synthetic origin along with the vaccine antigen through different vaccines inside our bodies.

HOW VACCINES WORK ?

Vaccines act as immune-modulators inside a living body. They influence the immune system of the body in the work of identification and then combating the infecting enemies by some easier fights. The invading pathogens, mainly some bacteria, and viruses, are prevented in that way. The vaccinal antigens are injected and the body recognizes them as some foreign particle and so deals with them in the same way as they do with invading micro-organisms. Thus, the immune system of the body becomes trained against the invading vaccinal antigen (mimicking the original pathogen) and produces antibodies against them and the character of the enemies is remembered by the cells engaged in this work. In any future infection of such microorganisms (bacteria or viruses), this knowledge of the immune system of the body is utilized and the already sensitized soldiers can perform the work of fighting and eliminating the enemies in a far better way so that they cannot multiply to cause any serious illness [11, 12].

FAILURE AND SIDE EFFECTS OF VACCINES

A. Failure of vaccines

Vaccination failure means the development of a specific disease in a vaccinated individual despite getting the vaccine. Such a condition may develop due to actual failure of the vaccine or due to failure to vaccinate the individual appropriately [5, 13].

Vaccine failure can be divided into two categories.

Primary vaccination failure

When the recipients of a vaccine fail to develop protective antibodies, the condition is termed primary vaccine failure. The main reasons behind such failure are the deficiency in the immunity power of the individuals to show proper response to the vaccines.

Secondary vaccination failure

In that type of vaccine failure, the patients develop a normal immune response after vaccination initially

but fail to prevent disease after getting a natural infection. Usually, the protective effect of most of the vaccines wanes over time, particularly in the absence of boosting doses and the chance of secondary vaccine failure increases over time [13, 14].

B. Factors affecting failure of vaccination

1. Variation in the strain of the organism used in vaccine preparation and the infecting one.
2. Destruction of the protective epitope of the vaccinating antigen during the preparation of the vaccine.
3. Presence of insufficient antigen in the vaccine given to an individual to elicit protective immunity.
4. Damage to the vaccines due to improper storage and transport.
5. Improper administration of the vaccine to the recipients.
6. Presence of maternal antibodies among the children during vaccination.
7. Vaccination performed in the individuals already infected and incubating the disease organism.
8. Individuals less responsive to the vaccines due to genetic makeup, suffering from immunodeficiency diseases (such as AIDS), or due to other reasons.
9. Vaccinated Individuals stay under immunosuppressive medication.
10. Severe malnutrition, high parasitic load, anemia, etc. of the vaccine receptors.
11. Severe stress, staying in extreme heat or cold, fatigue, pregnancy, etc. can cause vaccine failure, which may be due to increased production of glucocorticoids.
12. Vaccination of a very small number of individuals against a widespread disease with high infectivity leads to failure of the development of herd immunity [1, 13, 14].

C. Side effects of vaccines

1. Showing symptoms of mild toxicity by the vaccinated individuals is very common after vaccination. Inflammation, edema, tissue necrosis, etc. near the area of vaccine inoculation are the common problems encountered after vaccination. Symptoms like pyrexia, restriction in limb movement due to pain, anxiety, depression, neurological complication, etc. are also commonly seen.

2. As the inoculated vaccines contain many synthetic and semi-synthetic substances along with antigens, there is always a chance of developing hypersensitivity reactions against one or more of such items. The severity of the reaction depends on various factors of the vaccinated person (genetic makeup, age, condition of health, etc.).

3. Low-level immune-suppression is common among vaccinated individuals. This may invite some other problems in individuals with some specific continued medication or having some pre-existing health disorders.

4. The stress of the vaccination can activate latent infections among some individuals [14, 15, 16].

5. It is argued that live viral vaccines can cause changes in virulence and species specificity of other related viruses after reaching the biosphere and can initiate rapid spread of some diseases among the population [2].

The identified gross side effects found within a very brief period after vaccinations are documented, but there are many grey areas. Nothing works inside a body system alone. The cumulative effects of vaccine ingredients with other xenobiotic residues, their long-term effects, etc. require vigorous study before coming to any final conclusion.

SUCCULENT BIOMEDICINES - THE WEAPON TO STRENGTHEN INNATE IMMUNITY

Innate immunity and vaccination

The innate or non-specific immunity of the body is considered the first line of defense against all kinds of invasions of the body. The invading components may be of different types - physical, cellular, chemical, biochemical, etc. The innate immunity system covers many preventive measures of the body - from primary barriers like skin, gut, nasal hair, lacrimal gland, etc. to activities of different phagocytic cells, gamma-delta (gd) T lymphocytes, Natural Killer cells, etc. as well as actions of different cytokines.

So, the arms of the innate immunity system start its action against the invading disease-producing pathogens at the very beginning. After crossing these barriers, an organism can proceed further to create any disease. The fighter cells of the host can recognize the pathogenic organisms by their pattern recognition receptors encoded by their germ-line and then trigger various types of mechanisms to remove those [12, 17].

Vaccination acts to modulate body immunity by acting on another arm of the immunity system of the body - the adaptive or acquired immunity system. Generally, vaccines cannot influence innate immunity to any noticeable extent.

A joint venture may be better than single

Modulation of the innate immunity system of the body added with disease-specific modulation of adaptive immunity by use of vaccination may have far more beneficial effects to the body system than the activity of vaccination alone. So, the joint venture of both arms (innate and acquired immunity) can be performed in the cases where vaccination is available or possible. In other cases, modulated innate immunity can be engaged to prevent many other diseases.

The innate immunity modifiers can be principapally of two types.

i) Following of designed lifestyle

There are some ways to influence the innate immunity power of the body. Along with correction of wrong food-drink habits (such as the exclusion of processed foods, chemicals, and chemical added drinks, nasty fats, and inclusion of fiber-rich foods, vegetables, fruits, etc. in the diet) and other lifestyle-related factors like a violation of body clock, and inclusion of positive factors like exposure to sunlight, practice of Yoga, ample physical exercise, etc. in the daily routine, the initiation and progression of almost all diseases can be strongly influenced by modulation of the immunity power of the body [18, 19].

ii) Use of succulent biomedicines

There are nearly 1200 identified plants having the power to combat infection of different disease-creating organisms [20, 21, 22]. There are also identified 934 plants with reported anti-cancer efficacies and 205 plants with anti-diabetic activities [19, 28]. There is a report of identified 124 edible succulent fruits, 238 vegetables and others as well as other edible nuts, seeds etc. having the capability to modulate the body immunity. Regular daily intake of fruit salad, vegetable salad and nut mixture and weekly intake of mixture of some spices made by the items selected purposefully from the lists can keep the body immunity at a very good level [12, 18, 28].

Infection and immunity of an individual is not any independent subject; rather related to the status of different health-related parameters. Many plants of these lists of the said articles are found common, so it is expected that they can be used to prevent or cure of all these diseases singly, or together. Edible capsules of the succulent parts of these medicinal plants can be prepared for their effective use. Production of succulent biomedicine capsules and global transportation of them under the cold chain to the consumer or patients can dramatically change the present scenario of the creation of diseases as well as their costly treatment [28]. The procedures related to the chemical-free production of such succulent biomedicines, their bio-preservation and encapsulation, and global transportation has been discussed in some earlier works [19, 21]. Succulent biomedicines can be prepared to be used as a therapeutic means to combat many other diseases. After performing the adoptive research, these medicines can be used therapeutically [20, 22].

MECHANISM OF ACTIVITY OF SUCCULENT BIOMEDICINES

Only very limited research has been performed to understand the mechanism of activities shown by the succulent parts of the medicinal plants, though the ethnic and rural people use medicinal plant parts at that condition most of the time [23, 24, 25]. The activities shown by succulent edible fruits and nuts may have similarities with succulent biomedicines, at least partially [18, 28].

The contemporary studies performed on the medicinal activities of plants are not efficient enough to disclose the complete medicinal activities of a plant. In most cases, the isolated phyto-constituents are studied, but it is just a partial study of a plant. A single medicinal plant contains thousands of phyto-constituents and all of them work together when used in an unaltered state, *i.e.*, a succulent state. In any other state, at their dry condition or after diluents extraction of the dry parts, only a part of these phyto-constituents are allowed to show their activities.The contemporary medicinal systems, from the traditional systems practiced presently like Ayurveda and allied systems (use dry plant parts directly), Homoeopathy (use an ethanol-extracted section of the dry plant parts generally), the modern medicine (analyze the diluents extracted section of the dried plant parts to get active principles) have limited their study within the dry parts of the medicinal plants. With reduced number, quantity and the changed state (non-natural) of the phyto-constituents available in these plant-derived medicines can never be expected to show the total efficacy of the medicinal plants [20].

The succulent biomedicines express their activities differently than the single or isolated compounds used in modern medicine. The following points may be related to the subject.

1. Most succulent biomedicine contains a good number of important micronutrients. These can act on the modulation of body immunity.

2. Following proper modulation of different arms of non-specific immunity - the weak or overactive immunity status of the body may be corrected.

3. Part or all of the available phyto-chemicals of an effective medicinal plant may have a specific ability to influence related arms of the immune system of the body to combat infective micro-organisms.

4. Rejuvenation of different body systems can be performed by succulent biomedicines that ultimately affect the overall body immunity. This is related to the 'Rasayana' concept of the Indian codified healthcare system, Ayurveda [26].

5. Exhibition of qualities like antioxidation, immuno-modulation, anti-inflammatory, cardiotonic, hepatoprotective, diuretic, anti-asthmatic, hypercholesterolaemic, etc. medicinal activities of various plant parts can modulate the whole immunity system of the body [18].

6. During the phytochemical analysis under modern medicine, it was found that even the dry parts of medicinal plants contain a huge number of medicinally active compounds of different chemical natures. These include flavonoids, polyphenols, carotenoids, ascorbate, curcumin, tocopherol, etc. Almost all of these are having some immunomodulatory power [18, 26].

7. Different phyto-constituents present in the succulent biomedicines can act together, so their collective effects are expressed during their use. In many cases, the isolated phytochemicals show toxicity in the possible therapeutic doses [18, 19, 20]. The NCI Natural Products Repository preserved the aqueous and organic solvent extracts of the dry parts of a huge number of reported medicinal plants (about 80,000) to check their therapeutic efficacy, but only very little success was achieved [29]. It is argued that the study of a section of the phyto-constituents of any medicinal plant is an incomplete idea to understand the actual efficacy of any medicinal plant [12, 20, 21]. Such limitation can be overcome by studying the succulent form of the biomedicines - as there may be in-house suppression of any possible ill-effect of one compound by others as well as potentiation of the positive effects. The presence of a very minute amount of one or more compounds (volatile, present at very low, undetectable amounts) may influence the overall total activity of succulent biomedicine to a large extent [20, 27, 28].

BENEFIT OF USE OF SUCCULENT BIOMEDICINES AS SOME IMMUNO-MODULATOR

1. Unlike vaccines, the effects of these are not confined to preventing only one or a few specific diseases of infective origin. It will boost the innate immunity power that can assist in the prevention of possible infection of all microorganisms.

2. As most of these medicines are recommended for oral or local use, so expected to have nil or negligible side effects. As no synthetic chemicals or animal product is added to these medicines, there is no chance of gathering any toxin in any organ or tissue of the body or initiation of any reaction due to the effect of added ingredients.

3. Most of these medicines are also having positive effects in the protection of other diseases of non-infective origins. These may be very important added effects without any additional intervention.

4. Many succulent biomedicines can act as suppliers of important nutraceuticals. Such additional effects are also very important in consideration to keep the body healthy and disease-free.

CONCLUSION

Along with the rationale use of vaccines to increase disease-specific immunity, the other arm of modulation of immunity of the individuals may be stressed to get further beneficial effects in the prevention of the diseases. For infectious diseases where no vaccination is possible and for all other non-infectious diseases, modulation of innate or non-specific immunity of the individuals may be the main weapon to combat them. Directed modification of lifestyle, food-drink style, intake of selected mixtures of succulent fruits, nuts, and vegetables, as well as the use of succulent biomedicines for prevention and control of diseases, can be the novel way to achieve that target.

REFERENCES

1. Tezard IR. Veterinary Immunology (10th edn.). 2018; Elsevier, 3251, Riverport Lane, St. Louis, Missouri 63043.

2. Pattanayak S, Manna S. Attenuated and modified vaccine viruses: do they act as a source of some other viral diseases? Explor Anim Med Res. 2023; 13(1), DOI: 10.52635/eamr/13.1.1-7.

3. Ellwanger JH, Chies JAB. Zoonotic spillover: Understanding basic aspects for better prevention. Genetics Molecular Biol 2021; 44: 1(Suppl 1), https://doi.org/10.1590/1678-4685-GMB-2020-0355.

4. Meadows AJ, Stephenson N, Madhav NK, Oppenheim B. Historical trends demonstrate a pattern of increasingly frequent and severe spillover events of high-consequence zoonotic viruses. BMJ Glob Health 2023; 8: e012026. DOI:10.1136/bmjgh-2023-012026.

5. Tizard IR. Vaccines for Veterinarians, Chapter 1 - A brief history of veterinary vaccines. 2021; Elsevier. https://doi.org/10.1016/B978-0-323-68299-2.00010-1.

6. Smith ER. Different types of vaccine and its characteristics. J Clin Chem Lab Med. 2022; 5(11): 1000255.

7. Nguyen-Contant P, Sangster MY, Topham DJ. Squalene-based influenza vaccine adjuvants and their impact on the hemagglutinin-specific B cell response. Pathogens. 2021; 10(3), DOI: 10.3390/pathogens10030355.

8. Fox CB, Carter D, Kramer RM, Beckmann AM, Reed SG. Current status of toll-like receptor 4 ligand vaccine adjuvants, (Chapter 6). In: Schijns VEJC, O'Hagan DT, editors. Immunopotentiators in Modern Vaccines (2nd edn.), 2017; Academic Press. https://doi.org/10.1016/B978-0-12-804019-5.00006-2.

9. NCIRS fact sheet, Vaccine components. National Centre for Immunization, Research and Surveillance. 2013; https://www.ncirs.org.au/sites/default/files/2018-12/vaccine-components-fact-sheet.pdf.

10.Vaccine ingredients fact sheet. Immunisation advisory centre, University of Auckland, 2014; 01-11. http://vicparkmed.co.nz/wp-content/uploads/2014/08/ConcernVaccineIngredients20140522V01Final.pdf.

11. Dai X, Xiong Y, Li N, Jian C. Vaccine types. In: Vaccines - the history and future. Kumar V, (Editor). Intech Open; 2019. Available from: http://dx.doi.org/10.5772/intechopen.84626.

12. Pattanayak S. Succulent biomedicines - an effective way of getting protection against diseases through immunomodulation. Explor Anim Med Res. 2020; 10(2): 112-123.

13. Heininger U, Bachtiar NS, Bahri P, Dana A, Dodoo A *et al.* (2011) The concept of vaccination failure. Vaccine. 2011; 30(7), DOI: 10./j.vaccine.2011.12.048.

14. Tizard IR. Vaccine failure and other adverse events in animals. MSD Vety Mannual. 2022; https://www.msdvetmanual.com.

15. Wiedermann U, Garner-Spitzer E, Wagner A. Primary vaccine failure to routine vaccines: Why and what to do? Hum Vaccin Immunother. 2016; 12(1), DOI: 10.1080/21645515.2015.1093263.

16. Speers D. The vaccine non-responder. Virology. 2015; 17(2), http://www.ogmagazine.org.au.

17. Kasper DL, Fauci AS, Hauser SL, Longo DL, Jameson JL *et al.* Harrison's principles of internal medicine. 19 th edn. 2015; McGraw-Hill Education.

18. Pattanayak S. Healthcare system using succulent parts of plants, Volume II: Steps for production and marketing of some selected healthcare products. 2019; ISBN: 978-93-5391-625-1.

19. Pattanayak S. Prevention and control of diabetes by intake of succulent biomedicines and following of designed lifestyle: A ready plan for execution. Internati J Scientif Res Updates. 2022; 03(02): 081-103.

20. Pattanayak S. Healthcare system using succulent parts of plants, Volume I: For infectious diseases. 2019; ISBN: 978-93-5346-842-2.

21. Pattanayak S. Anti-COVID-19 biomedicines - A layout proposal for production, storage and transportation. The Open COVID J. 2021; DOI: 10.2174/2666958702101010166.

22. Pattanayak S. Alternative to antibiotics from herbal origin - outline of a comprehensive research project. Current Pharmacogenom Personali Medic. 2018; 16, DOI: 10.2174/1875692116666180419154033.

23. Panda SP, Ravi Prasad, DebBarman R. Some potential medicinal plants used by the tribals of Angul district, Odisha, India. Explor Anim Med Res. 2023; 13(S), DOI: 10.52635/eamr/13(S)71-77.

24. Maity P, Mahakur B. Studies on some American exotic weeds of Paschim Medinipur distrct of West Bengal, India, and their medicinal uses. Explor Anim Med Res. 2023; 13(S), DOI: 10.52635/eamr/13(S)109-118.

25. Das A, Ngente NN, Bhattacharya P, Kar S, Datta BK. An ethnobotanical survey of plants used by the people of the Hmar tribe of Dima Hasao district, Assam, North East India. Explor Anim Med Res. 2023; 13(S), DOI: 10.52635/eamr/13(S)141-147.

26. Kumar D, Arya V, Kaur R, Bhat ZA, Gupta VK *et al.* A review of immunomodulators in the Indian traditional healthcare system. J Microbiol Immunol Infect. 2012; 45: 165-184.

27. Pattanayak S, Mandal TK, Bandyopadhyay SK. Validation and therapeutic use of succulent plant parts - opening of a new horizon of alternative medicine. Explor Anim Med Res. 2016; 6(1): 08-14.

28. Pattanayak S. Anti-cancer plants and their therapeutic use as succulent biomedicine capsules. Explor Anim Med Res. 2023; 13(S), DOI: 10.52635/eamr/13(S)01-50.

29. Developmental therapeutics program (DTP) (2021) The NCI Natural Products Repository (2021), Division of cancer treatment and diagnosis, National Cancer Institute, 9609 Medical Center Drive, Bethesda/Rockville, MD20850, United States. https://dtp.cancer.gov/organization/npb/introduction.htm.

Cite this article as: Pattanayak S. Limitations of the contemporary vaccines: how to overcome? Explor Anim Med Res. 2023; 13(2), DOI: 10.52635/eamr/13.2.140-145.

Explor Anim Med Res,
Vol.13, Issue - 1, 2023, p. 1-7
DOI : 10.52635/eamr/13.1.1-7

ISSN 2277- 470X (Print), ISSN 2319-247X (Online)
Website: www.animalmedicalresearch.org

Editorial

ATTENUATED AND MODIFIED VACCINE VIRUSES: DO THEY ACT AS A SOURCE OF SOME OTHER VIRAL DISEASES?

Shibabrata Pattanayak[1*], Sanjib Kumar Manna[2]

ABSTRACT: For effective control of several viral diseases, live virus vaccines are given preference over killed or inactivated vaccines for their higher immunogenic potentials. Live virus vaccine strains are developed by attenuation by passaging in non-natural host species, tissues, embryonated eggs, etc., or by transferring viral genes/genomes to some other vector virus. The attenuated viruses fail to infect the species of their choice; though can elicit immunity when used as vaccines. The vector viruses are modified by the addition of a section of the genome of the disease-producing viruses in their genome to offer the desired immunity in vaccinated humans or animals. During mass vaccinations, the attenuated live viruses or vector viruses spread in the biosphere. It is suspected that many erstwhile low-profile disease agents genetically related to the viruses used in live vaccine production are causing more severe disease symptoms, changing tissue or organ of predilection, and even changing or broadening host species specificity. Three representative viral diseases affecting three species (human, goat, and cattle) are discussed as examples to enlighten the possible linkage between the spread of the attenuated or vector viruses in the biosphere and the increased virulence of related disease-producing viruses.

Key words: Live virus vaccine, Mutation, Adenovirus, COVID-19 vaccine, Lumpy Skin Disease, Goat Pox vaccine, Peste des Petits Ruminants, Rinderpest Vaccine.

Vaccination is an indispensable tool to induce specific immunity against specific pathogens in an active and acquired manner. Another form of active immunity development happens following natural means - by clinical or subclinical infections followed by recovery.

In contemporary vaccinology, control of infective viral diseases is mainly performed by vaccination. The vaccine types available to prevent viral diseases are live-attenuated vaccines, inactivated vaccines, replicating and non-replicating viral vector vaccines, DNA vaccines, RNA vaccines, recombinant vaccines, etc. (Tezard 2018, Dai *et al.* 2019).

As the killed or inactivated virus vaccines are less efficient to confer strong and long-lasting immunity, the attenuated live disease-causing viruses or other viruses with segments of their genome became the main techniques of vaccine production. So, live vaccines constitute the bulk of viral vaccines used in humans and animals. Live vaccines are made of avirulent strains of a disease-causing agent: either naturally avirulent or less virulent strains are used or virulent strains are made avirulent through passage/ forced replication in unnatural hosts such as unnatural host species, tissue culture, or embryonated eggs.

Like other fields of science, the technologies for vaccine development are changing fast, as we see in the use of vector-vaccines or RNA vaccines against the SARS-CoV-2 virus during the COVID-19 pandemic. Live virus vaccines are preferred over killed vaccines because of their replication in the host body and thus higher immunogenic ability. However, the use of live viruses or their genetic materials in vaccination may also cause the spread of those viruses or their genetic materials in the biosphere which may undergo mutation or recombination. There are some suspicions of the occurrence of new viral diseases, an increase in the pathogenicity of some lowly pathogenic viruses, a change in the host specificity of the viruses, etc. pointing to the use of live vaccines. Few such suspected examples are put forward to get some direction towards prevention of such problems in the future.

A. ADENOVIRUS INFECTION OF CHILDREN AND COVID – 19 VACCINES

Adenovirus infection is generally limited to mild flu-like symptoms among healthy individuals but may cause severe illnesses among individuals with lower immunity status or having pre-existing cardiac or respiratory

[1]*Associate Editor,* [2]*Editorial Board Member, Exploratory Animal and Medical Research.*
**Corresponding author. e - mail: patanayak1966@gmail.com*

diseases (CDC 2022). But in recent times, particularly during the late COVID-19 pandemic years, kids up to five years of age having no previous record of any serious or co-existing insufficiencies are suffering from symptoms of severe breathing difficulties to acute hepatitis leading to death in some cases after getting an infection of adenovirus (https://www.thelancet.com 2022, Wang *et al.* 2022, https://www.thehealthsite.com 2023). In the UK, such acute hepatitis in children is suspected to be due to infection by adenovirus subtype 41, though the subtype was previously known to be linked only with mild to moderate gastrointestinal symptoms (https://www.thelancet.com 2022). Death of children due to adenovirus infection has been reported from many parts of the world covering almost all continents of the globe (Baker *et al*. 2022, Gong *et al*. 2022, https://www.thelancet.com 2022).

The sudden increase in virulence, change of affected organs and systems, and more vulnerability of children to the virus need the attention of the researchers.

There are few plausible explanations for such instances such as conspiracy of disease creation, sequelae of COVID-19 vaccination, infection of adeno-associated virus 2 with helper virus co-infection, etc. Some other hypotheses are the immunity deficit among children due to lack of exposure to pathogens during the COVID-19 lockdown period, relaxation of lockdown caused a massive wave of adenovirus, past infection or co-infection, exposure to certain toxins or drugs, environmental factors that changed immunity to the virus among children, etc. (https://www.thelancet.com 2022). However, the affected children probably were not vaccinated against the COVID-19 virus (since they are up to 5 years of age) and the adenovirus infection with higher virulence is not confined to a single country (Baker *et al.* 2022, https://www.thelancet.com 2022, Gong *et al.* 2022), and as such the raised hypothesis are perhaps not supported by sufficient logic.

Adenovirus is used as a vector for the preparation of vaccines

Adenoviruses are non-enveloped, medium-sized, double-stranded DNA viruses with icosahedral nucleocapsid. Adenoviruses are having the ability to drive expression of the target antigen among the vaccinated entities strongly, and so it is preferred for use as a vector for other candidate vaccine viruses. Over 150 adenoviruses have been characterized from different primate species, mostly to assess their capability for use as vaccine vectors. The virus is used as a vector in the preparation of vaccines against Acquired Immuno-Deficiency Syndrome (AIDS), Zika virus disease, Ebola virus disease, malaria, and tuberculosis. For COVID-19 vaccine preparation, the human (adenovirus 5 and adenovirus 26) and chimpanzee serotypes were mainly tried. In adenovirus vectored vaccine preparation, generally, the E1 and E3 viral genes are deleted and replaced with the transgene of interest for the expression of desired antigen(s). COVID-19 vaccines such as Ad26.COV2-S by Janssen/Johnson & Johnson, ChAdOX1-nCoV by Oxford/AstraZeneca, Ad5-nCOV by CanSino Biological Inc, Gam-COVIDVac/ Sputnik V by the Gamaleya Research Institute, etc. are prepared using adenovirus as vector (Mendonça *et al.* 2021).

Adenoviral diseases of animals

Adenoviruses can infect several vertebrate species like birds, reptiles, bats, fish, amphibians, etc. The important adenoviral diseases of the animals that stay close to humans are Infectious Canine Hepatitis (ICH) and Kennel cough in dogs, adenoviral respiratory infections in horses, cattle, pigs, sheep, and goats, etc. (Harrach *et al.* 2019). But there is no evidence of human infection from these animal adenoviruses so far (Sykes 2014).

Is there any mutation of the adenovirus infecting children?

Adenoviruses have been used as vectors in many previous vaccines created to control diseases like AIDS, Ebola, or Zika virus diseases. But such vaccinations were produced on much smaller scales and used in a limited number of individuals. None of those vaccines have been used at a large scale like the COVID-19 vaccines and different human and chimpanzee strains of adenoviruses have been used for making COVID-19 vaccines (Jacob-Dolan and Barouch 2022). This enhances the chance of the spread of the adenovirus gene and/or its modified genome among humans, animals as well as in the virus population in recent times.

Children below five years of age are having much less susceptibility to suffering from COVID-19 and have a chance of getting any other vaccine with an adenovirus carrier (https://www.thelancet.com 2022). So, possibly they did not have sufficient antibodies against adenoviruses or their modified genomes used in different vaccine preparations which might make them vulnerable to infection of any genetically modified virulent adenovirus. This also raises suspicion of any relation between the spread of genetically modified adenoviruses or their modified genes in the biosphere (maybe by the related Covid-19 vaccines) and the change in virulence

and organ or system specificity of the adenoviruses infecting kids!

B. LUMPY SKIN DISEASE AND GOAT/ SHEEP POX VACCINES

Lumpy skin disease (LSD) is a disease of cattle caused by a Poxvirus, a double-stranded DNA virus. The main symptoms of the disease are fever, the formation of large nodules in the skin over the neck and other body parts as well as on the mucous membrane of internal organs like digestive and respiratory tracts (Mulatu and Feyisa 2018). The causative agent of LSD belongs to the genus Capripoxvirus that also includes Sheep pox virus (SPV) and Goat pox virus (GPV) (Barrett and McFadden 2008); these viruses share many genes that lead to the idea that they have originated from a common ancestor. LSD virus genes and proteins have also a high degree of similarity with many other viruses of the same family, like Suipoxvirus, Leporipoxvirus, and Yatapoxvirus (Tulman *et al.* 2002).

The vaccines prepared from sheep pox or goat pox viruses are partially protective against LSD in cattle (Coetzer and Tustin 2004, Hamdi *et al.* 2020).

Is there any relation between SPV or GPV with increased incidence and death by LSD?

As per the old reports, the morbidity of LSD generally varies between 2 - 45% and the mortality is generally less than 10 %. The susceptibility to the disease is dependent on the immunity status and breed of the animal; the European breeds are more susceptible than the breeds from Africa and Asia (Tuppurainen *et al.* 2017). But in the recent LSD outbreaks in India, a much higher rate of morbidity and mortality of infected cattle are found.

Among a huge number of infected cattle, more than 1.65 lakh cattle died in a few months in India (https://www.thehindu.com, https://www.outlookindia.com, Down to earth 2023).

The goat pox or sheep pox vaccines used routinely are all live-attenuated vaccines and are used for the vaccination of a large number of sheep and goats every year. LSD virus is generally not used to vaccinate cattle. Goat or sheeppox viruses are genetically very closely related to LSD viruses. There are some minute differences in the genomes as well as in the surface antigens of these three viruses (sheep pox, goat pox, LSD). But LSD infection has been noticed among the cattle vaccinated with goat pox virus recently (Down to earth 2023).

Due to the rapid spread of the 'attenuated' strains of the live viruses in the animal population as well as in the biosphere following mass vaccination, there was an increased scope of mutation in the genome of any of them.

Suspicion arises, is it the modified strain of LSD that broke the resistance of the cattle and caused havoc loss in India with the recent LSD outbreak?

C. PESTE DES PETITS RUMINANTS (PPR) AND RINDERPEST VACCINES

Peste des petits ruminants (PPR) is a disease of sheep, goats, camel, and many other wild ruminants. It is caused by a member of the genus Morbillivirus of the family Paramyxoviridae, an enveloped virus with a non-segmented negative-strand RNA genome. The PPR virus is having only one serotype, but it can be differentiated into four lineages by nucleic acid sequencing (WOAH 2020). PPR is characterized by acute onset of fever and anorexia, followed by serous nasal discharge, necrotic stomatitis, conjunctivitis, respiratory distress, severe diarrhea, emaciation, dehydration, dyspnoea, and death within 5-10 days. The disease can cause a huge loss of the susceptible population by its very high morbidity (90-100%) and mortality rates (50-100%). The disease is transmitted by aerosols, direct contact, and via fomites from the affected animals to the susceptible. So, nasal discharge, tears, cough, and all other secretions and excretions of the animals during the incubation period as well as during the diseased condition contain infective viruses (Golchinfar *et al.* 2011, Balamurugan *et al.* 2014, WOAH 2020).

Interrelations between PPR and Rinderpest viruses

The PPR virus of caprine, the Rinderpest virus of cattle, and the Measles virus of humans possibly diverged from a common precursor (Tezzard 2021). The Canine Distemper virus is also having antigenic similarities with these viruses (WOAH 2020). Very close similarities are found between the PPR and Rinderpest virus genome, antigenicity, as well as in disease symptoms. An incubation period of a few days followed by depression, anorexia, and development of ulcers in the mucous membranes leading to respiratory distress, diarrhea, and death are the common symptoms found in both of them (Wohlsein and Saliki 2006, Golchinfar *et al.* 2011, Tezzard 2021). The vaccines prepared by milder strains of PPR viruses to control the PPR of goats can also partially inhibit the Rinderpest virus in cattle, but only vaccination by wild type of PPR virus can protect cattle from the Rinderpest virus challenge (Holzer *et al.* 2016).

One study found that after vaccination by PPR vaccines, the antibodies cross-react with live Rinderpest virus, and the reverse reaction was also observed

Table 1. Examples from three different species for possible correlation with initiation/ potentiation of other viral diseases by use of live virus as some vaccine item.

Disease with increased virulence	Main symptoms	Previous history of the virus	Contemporary concepts	Related vaccine	Similarity, between the viruses	Possible reason/s and alike disease/s in other animals
Adenovirus infection of children	Acute hepatitis and respiratory distress	Caused mild flu like symptoms	Conspiracy of disease creation, sequelae of COVID-19 vaccination, infection of Adeno associated virus 2 with helper virus co-infection, lack of exposure to pathogens in lockdown period, relaxation of lockdown caused massive wave of Adenovirus, past infection or co-infection, exposure to certain toxins or drugs, environmental factors, etc.	COVID-19 Vaccines (Vector vaccine)	Modified genome of related strain used directly	Vaccine strains may act as modifying agent of any prevailing strain after reaching to the ecosystems.
Lumpy Skin Disease (LSD) of cattle	Fever, enlarged lymph nodes under skin and other body parts, mucous membrane of internal organs, very high morbidity and mortality rate	Can cause similar type of diseases among sheep, goat	A separate disease than sheep pox or goat pox.	Goat pox vaccine (live, attenuated)	Antigenically close, partially cross - protective	Vaccine strains act with other strains or assist to mutate to become more infective and pathogenic after reaching the biosphere
Peste des Petits Ruminants (PPR) of goat and sheep	Acute onset of fever, anorexia, followed by serous nasal discharge, necrotic stomatitis, conjunctivitis, respiratory distress, severe diarrhoea, emaciation, dehydration, dyspnoea and death within 5-10 days	Similar type of lesions were found in Rinderpest of cattle, presently declared as eradicated.	A separate disease, not related with Rinderpest vaccine	Rinderpest Vaccine (Goat adopted, rabbit adopted, bovine kidney cell cultured live vaccines)	Antigenically close, partially cross - protective	PPR and Rinderpest are having same ancestor; any of the goat adopted or other type of live viruses used in vaccines may caused mutation and increase in infectivity of the PPR virus.

(Couacy-Hymann *et al.* 2006). So, these two viruses are very close in consideration of antigenicity, genome structure, disease symptoms, etc.

Vaccines used for more than fifty years to control Rinderpest

For vaccine development, the virulent Rinderpest virus was injected into the living goats for successive generations. By such serial passage inside the non-natural host of the Rinderpest virus (non-cattle host), the virulence of the Rinderpest virus was reduced. Then the 'caprinized' strain of Rinderpest virus was injected into cattle as some attenuated live virus vaccine. The process continued up

to the 1950s. The virulent Rinderpest virus was similarly passaged in living rabbits for 600 generations to get the 'lapinized' strain of Rinderpest virus to use as a live, attenuated vaccine for cattle. These two types of vaccines (caprinised and lapinized) were used in cattle up to the 1960s. Afterward, the Rinderpest virus was cultured in bovine kidney cells up to at least 95 subcultures before use as tissue culture attenuated live viral vaccine (Tezzard 2021).

Rinderpest disease of cattle is already declared irradiated by vaccination in 2011 after ceasing vaccination totally from 1997 in India (NPRSM 1997) and 2006 from the globe (Tezzard 2021).

Why PPR is so violent?

Almost all strains of the PPR virus are highly virulent. No mild strain of the PPR virus is identified (Wohlsein and Saliki 2006). Previously, the disease was not so common. The magnitude of PPR has increased only in the recent past (NABC 2013).

Initially, the Rinderpest virus was passaged into living goats, then into living rabbits for generations. Then the tissue culture attenuated live virus vaccines came to the field for use. Vaccination against Rinderpest continued for a few decades. If we consider the time frame, along with widespread vaccination and the resultant reduction of cases of Rinderpest among cattle and afterward emergence of highly pathogenic strains of PPR have emerged! This raises suspicion whether the spread of the vaccine virus in the biosphere has led to an increase in its virulence and/or change in species specificity over time.

D. HORIZONTAL GENE TRANSFER AMONG VIRUSES: ROLE OF HOST AND VIRUSES

There are proofs of the transfer of part of the viral genome into the host cell (Desfarges and Ciuffi 2012) and also the transfer of the host genome into viruses (Caprari *et al*. 2015, Weiss 2017). There are also identified evidences of horizontal transfer of part of the viral genome into other related as well as unrelated viruses (Caprari *et al.* 2015, Koonin and Krupovic 2022). In such a condition, the assumption of horizontal transfer of viral gene/genome to related viruses getting a fair chance of interaction and formation of more potent viruses with changed species specificity cannot be considered as pure hypothetical assumptions.

During mass vaccination, both in humans and animals, the spread of the genome of vaccine viruses, carrier viruses, as well as the modified genomes themselves, get ample chance to spread in the host population as well as in the entire biosphere (Caprari *et al*. 2015, Makarenkov *et al.* 2021). Along with related or unrelated pathogenic viruses, many non-pathogenic viruses living in our immediate environment and the biosphere can come into their contact. The mixing vessel effect can contribute to the development of more pathogenic viruses or conversion of non-pathogenic viruses to pathogenic ones or donating the power to change the species specificity towards any non-natural species of animals or humans cannot be ruled out easily. Examples of three such important diseases infecting three different species and causing huge loss and harm in recent years in different parts of the world are also displayed in a tabular form (Table 1).

CONCLUSION

The practice of vaccination with modified live viruses, their relatives, or by genetic engineering of any virus to get desired protection level in humans and animals has got tremendous momentum in recent years. But these processes may have some other sides also. Three examples of such live vaccines and suspected cases of change of virulence and species specificity of other related viruses are analyzed to highlight some of the problem areas. Time has come to understand these problems and searching out of any adjunct or alternate way to overcome them.

REFERENCES

Baker JM, Buchfellner M, Britt W, Sanchez V, Potter JL *et al.* (2022) Acute hepatitis and Adenovirus infection among children - Alabama, October 2021–February 2022. Morbidity and Mortality Weekly Report 71(18): 638-640.

Balamurugan V, Hemadri D, Gajendragad MR, Singh RK, Rahman H (2014) Diagnosis and control of Peste des petits ruminants: a comprehensive review. Virus Dis 25(1): 39-56. DOI: 10.1007/s13337-013-0188-2.

Barrett JW, McFadden G (2008) Origin and evolution of poxviruses. In: Origin and evolution of viruses, 2nd edn. Elsevier 431-446.

Caprari S, Metzler S, Lengauer T, Kalinina OV (2015) Sequence and structure analysis of distantly-related viruses reveals extensive gene transfer between viruses and hosts and among viruses. Viruses 10: 5388-5409; DOI: 10.3390/v7102882.

CDC (2022) Center for Disease Control and Prevention. Adenovirus symptoms. https//www.cdc.gov/adenovirus/symptoms.html.

Coetzer JAW, Tustin RC (2004) Infectious diseases of livestock, 2 nd edn. Oxford University Press, Cape Town.

Couacy-Hymann E, Bodjo SC, Danho T (2006) Interference in the vaccination of cattle against Rinderpest virus by antibodies against Peste des petits ruminants (PPR) virus. Vaccine 24(29-30): 5679-5683. DOI: 10.1016/j.vaccine.2006.04.052.

Dai X, Xiong Y, Li N, Jian C (2019) Vaccine types. In: Kumar V (Ed.) Vaccines - the history and future. Intech open. DOI: http://dx.doi.org/10.5772/intechopen.84626.

Desfarges S, Ciuffi A (2012) Viral integration and consequences on host gene expression. Viruses: Essential agents of life. 25: 147-75. DOI: 10.1007/978-94-007-4899-6_7.

Down to earth (2023) Lumpy skin disease: Indian vaccine awaiting approval for 10 months even as more cattle fall prey. www.downtoearth.org.in. Downloaded on 07 June 2023.

Golchinfar F, Madani R, Tara Emami T (2011) Differentiating Pestes des petits ruminants and Rinderpest viruses by a novel monoclonal antibody. Hybridoma (Larchmt) 30(3): 291-295. DOI: 10.1089/hyb.2010.0108.

Gong K, Xu X, Yao J, Ye S, Yu X *et al.* (2022) Acute hepatitis of unknown origin in children: A combination of factors. Frontiers Pharmacol. DOI: 10.3389/fphar.2022.1056385.

Hamdi J, Bamouh Z, Jazouli M, Boumart Z, Tadlaoui KO *et al.* (2020) Experimental evaluation of the cross-protection between Sheeppox and bovine Lumpy skin vaccines. Scientific Reports 10: 8888. https://doi.org/10.1038/s41598-020-65856-7.

Harrach B, Tarján ZL, Benkõ M (2019) Adenoviruses across the animal kingdom: a walk in the zoo. Febs Letters 593(24): 3660-3673. https://doi.org/10.1002/1873-3468.13687.

Holzer B, Hodgson S, Logan N, Willett B, Baron MD (2016) Protection of cattle against Rinderpest by vaccination with wild-type but not attenuated strains of Peste des petits ruminants virus. J Virol 90: 5152-5162. DOI: 10.1128/JVI.00040-16.

https://www.outlookindia.com/national/lumpy-skin-disease-caused-over-1-5-lakh-cattle-deaths-in-2022-rajasthan-accounted-for-nearly-half-news-243704. Downloaded on 07 April 2023.

https://www.thehealthsite.com/diseases-conditions/adenovirus-killing-kids-with-severe-breathing-issues-in-kolkata-warning-symptoms-and-prevention-tips-956063/ Thehealthsite.com (2023) Adenovirus killing kids with severe breathing issues in Kolkata: Warning symptoms and prevention tips. Downloaded on 25 April 2023.

https://www.thehindu.com/news/national/explained-what-is-the-lumpy-skin-disease-affecting-cattle-in-india-what-are-its-economic-implications-and-does-it-affect-milk-for-consumption/article65911590.ece. Downloaded on 02 May 2023.

https://www.thelancet.com/journals/laninf/article/PIIS1473-3099(22)00296-1/ (2022) Explaining the unexplained hepatitis in children. Lancet Infect Dis 22(6): 743. DOI: 10.1016/S1473-3099(22)00296-1. Downloaded on 17 April 2023.

Jacob-Dolan C, Barouch DH (2022) COVID-19 vaccines: Adenoviral vectors. Annu Rev Med 73: 41-54. https://doi.org/10.1146/annurev-med-012621-102252.

Koonin EV, Krupovic M (2022) A life LINE for large viruses. eLife. 11: e83488. https:// doi. org/ 10. 7554/ eLife. 83488.

Makarenkov V, Mazoure B, Rabusseau G, Legendre P (2021) Horizontal gene transfer and recombination analysis of SARS-CoV-2 genes helps discover its close relatives and shed light on its origin. BMC Ecol Evo 21: 5. https://doi.org/10.1186/s12862-020-01732-2.

Mendonça SA, Lorincz R, Boucher P, Curiel DT (2021) Adenoviral vector vaccine platforms in the SARS-CoV-2 pandemic. npj Vaccines 97: 1-14.

Mulatu E, Feyisa A (2018) Review: Lumpy skin disease. J Vet Sci Technol 9(3): 1-9. DOI: 10.4172/2157-7579.1000535.

National Agricultural Biosecurity Center (NABC) (2013) Peste des petits ruminants (PPR) technical information reporting guide. Kansas State University. https://www.k-state.edu/nabc/docs/tirgs/PPR2013_NABC_version1.pdf.

NPRSM (National Project on Rinderpest Surveillance and Monitoring) (1997) guidelines. In: Rinderpest Eradication Scheme, Animal Husbandry Extension Wing, Dept of Animal Husbandry and Animal Welfare, Govt. Of Puducherry, India. https://ahd.py.gov.in/rinderpest-eradication-scheme.

Sykes JE (2014) Infectious canine hepatitis. Canine and Feline Infectious Diseases 2014:182-186. DOI: 10.1016/B978-1-4377-0795-3.00018-1.

Tezard IR (2018) Veterinary Immunology (10 th. edn.) Elsevier, 3251, Riverport Lane, St. Louis, Missouri 63043.

Tizard IR (2021) Vaccines for Veterinarians, Chapter 1 - A brief history of veterinary vaccines, Elsevier. https://doi.org/10.1016/B978-0-323-68299-2.00010-1.

Tulman ER, Afonso CL, Lu Z, Zsak L, Kutish GF, Rock DL (2001) Genome of Lumpy skin disease virus. J Virology 75(15): 7122 -7130. DOI: 10.1128/JVI.75.15.7122-7130.2001.

Tuppurainen, E, Alexandrov T, Beltrán-Alcrudo D (2017) Lumpy skin disease field manual – A manual for veterinarians. FAO Animal Production and Health Manual No. 20. Rome. Food and Agriculture Organization of the United Nations (FAO). 1-60.

Wang C, Gao ZY, Walsh N, Hadler S, Lu QB, Cui F (2022) Acute hepatitis of unknown aetiology among children around the world. Infect Dis Poverty 11: 112. https://doi.org/10.1186/s40249-022-01035-2.

Weiss RA (2017) Exchange of genetic sequences between viruses and hosts. Curr Top Microbiol Immunol 407: 1-29. DOI: 10.1007/82_2017_21.

WOAH (World Organisation of Animal Health, OIE) (2020) Peste des petits ruminants. https://www.woah.org/fileadmin/Home/eng/Animal_Health_in_the_World/docs/pdf/Disease_cards/PESTE_DES_PETITS_RUMINANTS.pdf. Downloaded on 28 March 2023.

Wohlsein P, Saliki J (2006) Rinderpest and Peste des petits ruminants - the diseases. In : Rinderpest and Peste des petits ruminants, Elsevier Ltd. DOI: 10.1016/B978-012088385-1/50034-4.

Cite this article as: Pattanayak S, Manna S (2023) Attenuated and modified vaccine viruses: do they act as a source of some other viral diseases? Explor Anim Med Res 13(1): 1-7. DOI: 10.52635/eamr/13.1.1-7.

Explor Anim Med Res,
Vol.12, Issue - 2, 2022, p. 128-133
DOI : 10.52635/eamr/12.2.128-133

ISSN 2277- 470X (Print), ISSN 2319-247X (Online)
Website: www.animalmedicalresearch.org

Editorial

PLASTICS AND THEIR ADDITIVES REACHED THE BLOOD AND TISSUE SPACES: WHAT ARE THE POSSIBLE CONSEQUENCES?

Shibabrata Pattanayak

ABSTRACT: Microplastics, the tiny plastic particles are either manufactured for definite purposes or develop as the fragmented part of larger plastic materials. These can reach everywhere on the surface of our planet to do various detrimental impacts on humans and animals living on the land and in the sea, directly or after entering the food chain; on the overall biosphere as well as on the total environment by staying at a non-biodegradable state for centuries. The study of various health effects of microplastics is a comparatively new subject and different aspects of serious to very serious impacts of microplastics and their additives on health are becoming clear by such research. It is known that microplastics have already reached the tissues and become a reason for the death of fish and other edible or non-edible lives in the sea and water bodies. Possible effects of microplastics and their additive chemicals can be assumed from some experimental studies and the logical correlation of reports of such studies with the direct observations of the health status of living human beings. Recently it has been reported that microplastics and their additives already reached human blood and the placenta. Possible impacts of these chemicals on the endocrine system, their role in initiation and progression of different chronic diseases including cancers, effect on the brain, overall nervous system, and related behavioral changes as well as on the important organs of the body, like the liver, etc. are discussed in the light of published literature with an effort to search out the possible ways to reduce the load of microplastics and their additives inside our body to combat the incoming massacre.

Key words: Microplastics, Additives, Endocrine system, Cancers, Blood, Placenta, Health impacts.

We are now accustomed to plastics in almost every aspect of our life. Most of us already have some idea about the ill effects of plastics on our health and environment. Plastics cause pollution of the land, water bodies, rivers, and the sea along with the lives staying in their macro and micro-niches. More and more diverse health impacts of plastics on biota and health are being discovered day by day.

Synthetic plastic was first developed and used in 1907 in New York (Bakelite) (McCann 2021). The first plastic bag was used for health purposes (for collection and storage of blood) in 1950 (Walter 1951), and almost one decade later, the possible toxicity of plastic bags on human health was suspected (Gullbring 1964)!

Now we are using plastics for almost all household purposes. It is used in the pipelines and containers for storage and supply of drinking water and as some bags and packets for different purposes, from decorative packaging to storage and transportation of almost all industrial and household products, food, and drink items.

Plastics perhaps already reached everywhere on our planet. Plastic particles are found in the salt manufactured from the seawater and a good amount of plastics are present even in our feces (Campanale *et al.* 2020, Yee *et al.* 2021). Now it has been proved that the tiny plastic particles have already reached our blood and different tissue spaces (Braun *et al.* 2021, Leslie *et al.* 2022)!

Several articles are published on the toxicities of different plastics, their additives, etc. The detrimental effects of different plastics and their products on the sewage system, animal and bird health, marine life, the food chain, and the overall environment have also been discussed (UNEP 2018, Pattanayak 2018). Now, scientists are more worried about the health impacts of plastics!

The small-sized plastic particles are termed microplastics. Microplastics are some heterogeneous mixture of plastic materials of various shapes having sizes in the range of 0.1 to 5000 µm. The term nano-plastic is used to describe also some heterogeneous mixtures of further small-sized plastic mixtures, within the range of

Assistant Director, ARD (Vet. Res. Invest.), Govt. of West Bengal, India, and Associate Editor, Exploratory Animal and Medical Research.
**Corresponding author. e-mail: pattanayak1966@gmail.com*

0.001- 0.1 μm. These micro and nano plastics are either originally manufactured in the industry or originate after fragmentation of the plastic materials of larger size or their debris (EFSA 2016). These tiny forms of plastics are capable to enter the body systems of man, animals, and birds of land and water. Though these can cause systemic effects after entry through the gut, lungs, and skin epithelia, their total and cumulative effects on health have not been studied thoroughly (Yee *et al.* 2021). Only the effects of the ingested plastics and their additives are to some extent studied. It is presumed that if micro-plastics and/or their additives can accumulate inside the body, they can influence the activities of different important internal organs or can reach the tissues and fluids of the body directly by leaching to bring various unknown dangerous impacts on health (Yee *et al.* 2021). Depending upon the available study reports, a brief analysis of the possible effects of plastics and their different additives inside the body system is targeted in the present article.

ENTRY AND ACTIVITY OF MICRO-PLASTICS INSIDE OUR BODY

A. Source and spread of microplastics

Several studies have already shown that micro-and nano-plastics are entering the human food chain in different ways. Direct ingestion of plastics with contaminated food or from plastic-made food plates or water/liquid containers, plastic coats of paper-made containers, etc. are some visible sources. Animals consume plastics directly even in their natural environment considering them wrongly as some food. Plastics can mix with our foods as some contamination during food production, processing, and/or through leaching from the plastic packaging materials used to hold or cover the food and drinks. These are so potent to spread that the micro- and nano-plastic particles have already been detected in honey, sugar, beer, etc. (Talsness *et al.* 2009, Pattanayak 2018, Li *et al.* 2021)!

Entry of plastics into the food chain can cause easy and high-speed transfer of it to us. Plastics are found in the digestive tract and different tissues of fishes, shrimps, mussels, and many other edible or non-edible marine species (European Commission 2011, USEPA 2016, Bisht and Negi 2020), as well as in birds (Leavers *et al.* 2019).

The nano-plastics generally develop due to the degradation of the microplastic wastes and can enter more easily into the human food chain due to their smaller size. Not only in food, micro and nano-plastics are also identified in tap, bottled, and spring water at different concentrations (Campanale *et al*. 2020, Flaws *et al*. 2020, Yee *et al.* 2021). As per reports of some experimental studies, they are also able to enter the bloodstream, lymphatic system, etc., and even can reach different tissues and organs (Wright and Kelly 2017, Kistler *et al.* 2019, Campanale *et al.* 2020).

B. Common micro-plastics and plastic additives in food and drinks and their activities

Several categories of plastics can come in contact with the food ingredients at their primary stage, during food preparation and processing, during post-processing packaging and distribution as well as from the plastic-made or plastic-coated plates, cups, or spoons during the serving of the food. Among the added plastics, polyester, polyvinyl chloride, polyolefins, polyvinylidene chloride, polyamide, polystyrene, ethylene vinyl alcohol, etc. are common (Raj 2005, Pattanayak 2018).

Microplastics have both physical and chemical effects on the blood and tissue spaces of different internal organs of the body. Not only the microplastics but all additives and colorants added with plastics can also easily mix with food and drinks if these come in contact with the plastics at any stage before the dietary intake. Among these, the most dangerous chemicals are all loosely bound synthetic color materials, bisphenol A and its derivatives, and different types of phthalates used in plastics (Talsness *et al.* 2009, Pattanayak 2018). Other important chemicals capable of causing serious health impacts are brominated flame retardants and lead heat stabilizers (Wright and Kelly 2017). In addition to chemical additives, plastic can also leach hazardous residual monomers. Among them, polyvinyl chloride, epoxy resins, polyurethanes, and styrene polymers are identified as plastics of the greatest concern in consideration of their impacts on health and the overall environment, as monomers of these plastics can show carcinogenic, mutagenic, or both of these effects (Wright and Kelly 2017).

i) Disruption of activities of the endocrine system

Some synthetic chemicals are having chemical structures almost similar to some hormones. After reaching the bloodstream and tissues, these can mimic the hormones and can disrupt both the functions of hormones in their effector tissues or organs and the production of these hormones by inducing the wrong feedback signal. There are chemicals having similarities with insulin, estrogen, progesterone, etc. Their actions can bring many detrimental health effects and can increase the risk of the development of many dangerous chronic diseases (https://www.niehs.nih.gov/health/topics/agents/endocrine/index.cfm).

Different plastic components can reach and accumulate inside our bodies from different sources, but all of them can act together. Many of these are having structural similarities with some important hormones or they can influence their functions in the body. Components like bisphenol A (BPA), phthalates, bis (2- ethylhexyl) phthalate (DEHP), polybrominated diphenyl ethers (PBDE), and tetra-bromo-bisphenol A (TBBPA) have been detected in the human body. These chemicals can alter the balance of our endocrine system (Talsness *et al.* 2009). These are having strong influence to initiate many hazardous diseases like Polycystic Ovarian Syndrome (PCOS) (Rutkowska and Rachoñ 2014, Wright and Kelly 2017). Bisphenol A, a plastic additive, can play some decisive roles in inducing infertility in males and females (Huo *et al.* 2015). Bisphenol A competes with estrogen and testosterone for their receptors, altering the balance of these hormones inside the body and so influencing reproductive health. Phthalates can function as some anti-androgenic agent inside the body. Polybrominated diphenyl ethers (PBDE) and tetra-bromo-bisphenol A (TBBPA) can disrupt the homeostasis of thyroid hormones. PBDEs can also act as some anti-androgenic agents (Talsness *et al.* 2009).

ii) Increasing the risk of chronic diseases

It has been observed that long-term exposure to microplastics can increase the risk of the development of diseases like Type 2 diabetes and even some cardiac diseases (Song *et al.* 2015).

There are associations between the high level of plastic additives like phthalates, dioxins, and bisphenol A in blood with several inflammatory diseases, improper glucose metabolism, increased chance of obesity, development of insulin resistance, and Type 2 diabetes (Lucas *et al.* 2022).

According to some research reports, exposure to microplastics in foods can cause more harmful effects on the body than continuous intake of unbalanced diets in consideration of risks for the development of chronic diseases (Lobstein and Brownell 2021).

iii) Disruption of immunity of the body and invitation of diseases like cancers

Microplastic exposure leads to improper gut health, weakening of the immunity status of the body, as well as an increase in the rate of development of different inflammatory conditions. Intestinal dysbiosis associated with detrimental effects on important intestinal structures like Peyer's patches can ultimately cause many compromises in the activities of the normal body immunity (Hirt and Body-Malapel 2020, Campanale *et al.* 2020). The immunological impact of microplastics is also dependent on the chemical composition of the plastics, as PET (polyethylene terephthalate) can act as a more harmful agent than PE (polyethylene). Some microplastics are having strong ability to act as carcinogens (*e.g.*, butadiene, vinyl chloride, etc.), and some others are having strong power of mutagenicity (*e.g.*, phenol, benzene, etc.) (Wright and Kelly 2017).

iv) Possible effects on the brain and other important organs

Observing the effects of the nano-particles of gold or titanium dioxide (which was considered as some inert chemical inside the body at their natural entry), it is assumed that micro- and nano-plastics may have neurotoxic health impacts of severe nature after reaching the brain. These can cause oxidative stress, induce cellular damage, and increase the chance of the development of different neuronal disorders. These can cause inhibition of the activity of acetylcholine esterase and alter the levels of the neurotransmitter and so can bring behavioral changes (Prust *et al.* 2020)!

Microplastics can reach different important organs through blood and may cause many serious health hazards. It may even affect important organs like the liver to cause problems in the normal functioning of those organs (Wright and Kelly 2017, Kistler *et al.* 2019, Campanale *et al.* 2020).

TOXICITY MECHANISMS OF MICROPLASTICS AND THEIR ADDITIVES

There may be several types of local and systematic effects of plastics inside the blood, tissue spaces, and the depositing organs. Depending on the available research reports, an assumption can be made about all such possible effects.

The Microfold (M) cells of the Peyer's patches of the intestinal wall can engulf particles of micrometer-sizes. These cells engage in the transport of luminal antigens to lymphoid follicles to initiate an immune response in the body. The microplastic particles above 2.5 um are of great concern as these can be engulfed by the M cells and further transported. These particles can reach the bloodstream and then can be carried to different organ tissues. Due to the unique surface chemistry, hydrophobicity as well as bio-persistent nature of the microplastics, the toxic effects are developed inside the body. The development and strength of the toxicity effects are dependent on the rate of accumulation and reaching some optimal gathering point of the microplastics to start

their toxic effects (Wright and Kelly 2017). The effects of acute or chronic exposure to micro and nano fragmentation of polystyrene were studied in human intestinal CCD-18Co cells. It is found that these can induce different metabolic changes by initiating oxidative stress, affecting the pathways of energy metabolism and different anabolic processes, and thus can be a risk factor for cancers (Bonanomi *et al.* 2022).

Important physical responses of microplastics are the development of inflammatory conditions, oxidative stress, genotoxicity, increased rate of apoptosis, and tissue necrosis. The lipid membrane of the cells may be destabilized by the microplastics which can affect the functioning of the cells and even increase the rate of cell death (apoptosis). Effect on energy and lipid metabolism invites some neurotoxic responses which ultimately bring some serious consequences. In response to sustained biological responses due to microplastics, a range of other detrimental outcomes may be expressed. Different important organs may face continuous tissue damage, then fibrosis, and up to carcinogenesis (Wright and Kelly 2017, Campanale *et al.* 2020)!

The chemical effects of the microplastics are depended on the chemical character of the microplastic monomers. Leaching of the unbound chemicals like color materials from the plastic utensils, the additives, unreacted residual monomers, and desorption of the associated hydrophobic organic contaminants (HOCs) are the main factors that act in this episode. The actual health impacts of many such chemicals are still unclear to the researchers.

Microplastics can leach different residual monomers in addition to the added chemical additives. Polyvinyl chloride (PVC), polyurethanes, epoxy resins, styrene polymers, etc. are considered chemicals of great concern in consideration of health and environmental effects of their monomers which are known to have mutagenic, carcinogenic, or both effects (Wright and Kelly 2017).

All plastics contain chemicals that act as reactive oxygen species (ROS) generators. It has a relationship with their history of polymerization and processing. Weathering of the microplastics generally leads to the formation of free radicals which can show toxic activities at the cellular level (Wright and Kelly 2017, Lavers *et al.* 2019).

So, the cellular uptake of microplastics ultimately can transport the endogenous materials and adhered contaminants inside the cells to cause further detrimental health effects (Wright and Kelly 2017, Campanale *et al.* 2020).

SOME RECENT STUDY REPORTS

A. Plastics in blood

In a recent study, the presence of different microplastics was analyzed in the blood samples of some donors. The study report showed the presence of various types of microplastics in the blood samples. Fifty (50) percent of blood samples showed the presence of polyethylene terephthalate (PET), thirty-six (36) percent samples contained polystyrene (PS), twenty-three (23) percent contained polyethylene (PE), and five (5) percent samples are having polymethyl methacrylate (PMMA). PET is generally used in the packaging of beverages, soft drinks, synthetic or semi-synthetic fruit juices, and water. PS is used in containers of different foods and also on disposable cups and plates. PE is used in the bags to carry grocery items, frozen foods, food carry containers and their lids, etc. PMMA is a transparent thermoplastic and so generally used as an alternative to glass.

From the studies, the presence of microplastics in blood and their possible source can be assumed. According to some researchers, our body shows a reaction actually to the sum of all cumulative microplastics and other xenobiotics entering through various routes like air (lung), water (drinking and absorption), foods, drinks (bottles containing beverages, water, synthetic or preservative added fruit juices, edible oils, and such other items), ingested personal care products (lipstick, nail polish), dental polymers, polymeric drugs, fragments of polymeric implants, tattoo ink residues, etc. (Leslie *et al.* 2022, Pattanayak 2022).

B. Plastics in the placenta

A study was performed on the collected placentas from physiological pregnancies that were analyzed for the presence of microplastics in them. Microplastic fragments of 5 to 10 μm size with spherical or irregular shapes were identified from both placentas of the fetal side and the maternal side as well as in the chorio-amniotic membranes. Some of the microplastics were chemically identified as pieces of stained polypropylene, a thermoplastic polymer. But from many others, identification of the pigments was only possible. The identified pigments are generally used in coatings, plasters, paints, finger paints, polymers, adhesives, and different personal care products like cosmetics (Ragusa *et al.* (2021)! In another study, presence of polyethylene, polysterine and polypropylene was detected from the placenta and meconium samples (Braun *et al.* 2021).

CONCLUSION

Plastics are extensively used for the last few decades and now the time has come to be rational in their use. Not only their effects are found on the life of animals, birds of the land and fishes, and other marine animals, plastics reached the food chain and even in our blood and organ tissues. The main entry of plastics happens through the oral route, so it can be reduced to a large extent through personal consciousness. Limiting consumption of processed foods by depending more on traditional home-made foods, choosing eco-friendly food packaging by use of paper, jute, or cotton bags in packaging; replacing plastic water bottles, cups, food plates, utensils, etc. with suitable biodegradable natural materials or materials like glass or stainless steel, etc., we can slow down their environmental deposition and reduce the concentration of micro and nano plastics and/or their additives in our blood and tissue spaces.

REFERENCES

Bisht VS, Negi D (2020) Microplastics in aquatic ecosystem: Sources, trophic transfer and implications. Intern J Fisheries Aquatic Studies 8(3): 227-234.

Bonanomi M, Salmistraro N, Porro D, Pinsino A, Colangelo AM, Gaglio D (2022) Polystyrene micro and nano-particles induce metabolic rewiring in normal human colon cells: A risk factor for human health. Chemosphere 303: 134947. DOI: 10.1016/j.chemosphere.2022.134947.

Braun T, Ehrlich L, Henrich W, Koeppel S, Lomako I *et al.* (2021) Detection of microplastic in human placenta and meconium in a clinical setting. Pharmaceutics 13(7) : 921. https:// doi.org/10.3390/pharmaceutics13070921.

Campanale C, Massarelli C, Savino I, Locaputo V, Uricchio VF (2020) A detailed review study on potential effects of microplastics and additives of concern on human health. Int J Environ Res Public Health 17: 1212, DOI:10.3390/ijerph17041212.

EFSA Panel on Contaminants in the Food Chain (CONTAM) (2016) Presence of micro-plastics and nano-plastics in food, with particular focus on seafood. EFSA J 14(6): 4501.

European Commission (2011) Plastic waste: ecological and human health impacts, Science for environment policy, in depth report. Accessed on 17.05.2022.

Flaws J, Damdimopoulou P, Patisaul HB, Gore A, Raetzman L *et al.* (2020) Plastics, EDCs and Health. Endocrine Society, www.endocrine.org, 40-44.

Gullbring B (1964) The use of plastics in blood transfusion equipment with special regard to toxicity problems. Vox Sanguinis 9(5): 513-529. https://doi.org/10.1111/j.1423-0410.1964.tb03323.x

Hirt N, Body-Malapel M (2020) Immunotoxicity and intestinal effects of nano- and microplastics: a review of the literature. Part Fibre Toxicol 17(1): 57. https://doi.org/10.1186/ s12989-020-00387-7.

Huo X, Chen D, He Y, Zhu W, Zhou W, Zhang J (2015) Bisphenol-A and female infertility: a possible role of gene-environment interactions. Intern J Envir Res Public Health 12(9): 11101-11116. https://doi.org/10.3390/ijerph120911101.

Kistler A, Azoulay D, Villa P, Arellano Y, Gordon M *et al.* (2019) Plastic and health - the hidden costs of a plastic planet, Chapter four: Consumer use, 43-44. www.ciel.org/ plasticandhealth. Acessed on 12.05.2022.

Lavers JL, Hutton I, Bond AL (2019) Clinical pathology of plastic ingestion in marine birds and relationships with blood chemistry. FFSH Pathology, Natural History Museum. Downloaded on 16.05.2022.

Leslie HA, van Velzen MJM, Brandsma SH, Vethaak AD, Garcia-Vallejo JJ, Lamoree MH (2022) Discovery and quantification of plastic particle pollution in human blood. Environment Internat. https://doi.org/10.1016/ j.envint.2022.107199.

Li Y, Sun Y, Li J, Tang R, Miu Y, Ma X (2021) Research on the influence of microplastics on marine life. IOP Conf Series: Earth and Environment Science 631: 012006. DOI: 10.1088/ 1755-1315/ 631/1/012006.

Lobstein T, Brownell KD (2021) Endocrine-disrupting chemicals and obesity risk: A review of recommendations for obesity prevention policies. Obesity Reviews 22(11): e13332. https://doi.org/10.1111/obr.13332.

Lucas A, Herrmann S, Lucas M (2022) The role of endocrine-disrupting phthalates and bisphenols in cardiometabolic disease: the evidence is mounting. Curr Opin Endocrinol Diabetes 29(2): 87-94. DOI: 10.1097/MED.0000000000000712.

McCann SR (2021) Plastic in blood and wine. Bone Marrow Transplantation 56: 762-764. https://doi.org/10.1038/s41409-020-01052-5.

Pattanayak S (2018) Thrown plastics – cause of an incoming global disaster. Explor Anim Med Res 8(2):133-139.

Pattanayak S (2022) Research targeting business profits: impacts on health and environment. Explor Anim Med Res 12 (1): 1-7. DOI: 10.52635/eamr/ 12.1.1-7.

Prüst M, Meijer J, Westerink RHS (2020) The plastic brain: neurotoxicity of micro and nano plastics. Particle Fibre Toxicol 17: 24. https://doi.org/10.1186/s12989-020-00358-y.

Ragusa A, Svelato A, Santacroce C, Catalano P, Notarstefano V *et al.* (2021) Plasticenta: First evidence of microplastics in human placenta. Environment Intern 146: 106274.

Raj B (2005) Plastics and their role in food packaging, Food packaging Technology Department, Central Food Technological Research Institute, Mysore 570020, India. http://www.icpe.in/Plastics%20in%20Food%20Packaging/pdf/2-Final.pmd.pdf.

Rutkowska A, Rachoñ D (2014) Bisphenol A (BPA) and its potential role in the pathogenesis of the polycystic ovary syndrome (PCOS). Gynecol Endocrinol 30(4): 260-265. DOI: 10.3109/09513590.2013.871517.

Song Y, Chou EL, Baecker A, You NC, Song Y *et al.* (2016) Endocrine-disrupting chemicals, risk of type 2 diabetes, and diabetes-related metabolic traits: A systematic review and meta-analysis. J Diabetes 8(4): 516-32. DOI: 10.1111/1753-0407.12325.

Talsness CE, Andrade AJM, Kuriyama SN, Taylor JA, Vom Saal FS (2009) Components of plastic: experimental studies in animals and relevance for human health. Philos Trans R Soc Lond B Biol Sci 364(1526): 2079-2096.

United Nations Environment Programme (UNEP) (2018) Single-use plastics: a roadmap for sustainability. Available at : www.unenvironment.org/resources/report/single-use-plasticsroadmap-sustainability. Accessed on 21.12.2021.

USEPA (2016) A summary of literature on the chemical toxicity of plastics pollution to aquatic life and aquatic-dependent wildlife. State of the science white paper, Office of Science and Technology Health and Ecological Criteria Division, U.S. Environmental Protection Agency Office of Water, 01-50. Accessed on 17.05.2022.

Walter CW (1951) A technic for collection, storage, and administration of unadulterated whole blood. Surg Forum 1950: Amer College of Surgeons. Philadelphia, WB Saunders Co.

Wright SL, Kelly FJ (2017) Plastic and human health: a micro issue? Environ Sci Technol 51: 6634-6647. DOI: 10.1021/acs.est.7b00423.

Yee MSL, Hii LW, Looi CK, Lim WM, Shew-Fung *et al.* (2021) Impact of microplastics and nanoplastics on human health. Nanomaterials 11: 496. https://doi.org/10.3390/nano11020496.

Cite this article as: Pattanayak S (2022) Plastics and their additives reached the blood and tissue spaces: what are the possible consequences? Explor Anim Med Res 12(2): 128-133. DOI: 10.52635/eamr/12.2.128-133.

Explor Anim Med Res,
Vol.12, Issue - 1, 2022, p. 1-7
DOI : 10.52635/eamr/12.1.1-7

ISSN 2277- 470X (Print), ISSN 2319-247X (Online)
Website: www.animalmedicalresearch.org

Editorial

RESEARCH TARGETING BUSINESS PROFITS: IMPACTS ON HEALTH AND ENVIRONMENT

Shibabrata Pattanayak*

ABSTRACT: In contemporary research, funding is generally targeted toward assured and high business returns. In this business approach, studies for possible negative or side effects, especially the long-term use effects of the technologies and products are neglected or overlooked. Ample evidence related to the development of serious detrimental outcomes of many such improperly studied technologies before their widespread use is available in different aspects of the life of animals and plants, and on the overall environment of our planet. A few such examples of serious impacts on human health and the environment are cited in the article along with a brief discussion of the potentially risky application of such one-eyed research-derived technologies.

Key words: Research funding, Business, Health, Environment, Harmful impact.

In the present research concepts, business plays a very important role. Funding of research is directly related to high economic return or business in many cases. So, the creation of a market by influencing, modifying, or creating the requirement feeling or even intentionally creating problems of most individuals in a society, a country, or even bulk majority of people of the globe may be a broad yet unspelled objective of such research funding and administration. The announced statements available for such target-oriented research are always just some idealistic comments, like - such research is performed for the benefit of the common people, making their life easier and more comfortable, etc. Does this official show-case display the actual motto of a project hidden inside the files? Or, whether these are fed to us just to fulfill some hidden agendas targeting more and more business profits? A few such areas are discussed here.

SOME QUESTIONABLE AREAS

1. Instant gain/benefit versus long term damage

Many types of research are performed for showing beneficial research outcomes to the consumers without considering the adverse effects of their long-term use. It is perhaps performed to strengthen the "logic' to sell a new technology or item. As a result, people come to know the adverse impacts of many technologies/products after their widespread use for a long period (BSE fast fact 2008, Pattanayak 2014, Hela *et al.* 2018).

i) Cosmetics are tested on the skin of small laboratory animals for a short period to know possible side effects. The normal life spans of these animals are only a few years and human beings use such chemical mixtures continuously for a far longer time. The difference in the body system, metabolism, systemic effects of absorbed materials, effects on the environment, etc. points are not considered important or overlooked in such studies (Hela *et al.* 2018, Pattanayak 2019b). Thus, short-term studies on lab animals may not identify the long-term effects of such products in humans.

ii) It took a few centuries to understand the detrimental effects of toxic addictive substances like tobacco, alcohol, or cannabis. Different preparations of many such materials were advertised and used for such a long period!

iii) Birth control is important to check the population explosion and as a part of the modern lifestyle.

Assistant Director, ARD (Vet. Res. Invest.), Govt. of West Bengal, India, and Associate Editor, Exploratory Animal and Medical Research.
**Corresponding author. e-mail: pattanayak1966@gmail.com*

Contraceptive hormone pills are advocated worldwide for that purpose. Some side effects of the intake of these contraceptive pills, which often contain synthetic hormone mixtures at a high dose, are known (Sabatini *et al.* 2011). But study reports on health impacts in long-term continuous use of such synthetic hormones at the same dose irrespective of age or body weight, which act together with other xenobiotic residues inside the body, are not easy to find out!

iv) Oils containing trans-fats are considered detrimental to our health (Pattanayak 2019a). But the use of these hydrogenated vegetable oils (Dalda, Vanaspati, Margarine, etc.) containing trans-fats was considered healthy and even advertised as a better alternative to milk-derived butter or ghee and used for almost fifty years (the 1940s – 1980s). The trans-fats along with many other synthetic chemicals are taken regularly with processed and fried foods following the advertisement-based marketing, without giving any importance to the point that these may cause detrimental impacts on our health in such regular intake (Pattanayak 2017b, Pattanayak 2019a)!

v) Vegetarian cattle were fed scrap meat of sheep for getting better quality beef. Eating such beef caused Mad Cow Disease in humans after a few years (BSE fast fact 2008). But the event was identified at the cost of many lives.

vi) Several daily care FMCG products (fast-moving consumers' goods) such as toothpaste, mouthwashes, hand washes, shampoos, etc. contain extra fluoride, detergents, and strong antimicrobial agents that affect health, gut microflora as well as environment.

2. Effects versus side effects

Research funds are often granted to find the positive effects of the research proposals only and a negligible amount of money is earmarked to know the possible side effects, which may be to bypass the restrictions imposed by the relevant laws. These can cause many disastrous effects afterward.

i) The thalidomide episode

Widespread use of thalidomide was practiced in 1956 in Europe and Canada as an effective medicine with antiemetic and sedative activities in pregnant women. But it has resulted in the formation of a huge number of deformed infants. It was withdrawn in 1961 owing to such disastrous teratogenic effects at the cost of the lifelong suffering of many such deformed children (Shanbhag *et al.* 2006).

ii) Gastric ulcer from Aspirin

Aspirin has been used as an effective pain killer and many people were accustomed to taking this drug as and when felt required by them. But later it was found that it can cause erosion of the stomach from small sore up to the stomach perforation (US FDA 2008).

iii) Cumulative effects of radiations performed on the patients frequently without noticing previous exposures (from X-ray to CT scan) as a part of the diagnosis of the diseases may be dangerous. It may be far more detrimental to our health when added to radiation from mobile phones and their towers (Awosan 2016, Mitra and Pattanayak 2018).

iv) Serious collateral damages to important organs/systems may happen during the treatment of different diseases such as chemo-radiation therapy in cancer, hormone therapies, etc. But such side effects, unless very serious/life-threatening and acute, are often overlooked, as such study may reduce related business (Chen *et al.* 2007).

3. Stop or reduction of funding for less profit

Funding for a research project is generally reduced or stopped when considered economically non-viable or less feasible, despite the existence of larger needs of the society.

i) Funding in search of new antibiotics has been reduced due to a huge reduction in the business profits from the early development of antibiotic resistance among the microbes (Pattanayak 2017a, Pattanayak 2018a, Plackett 2020).

ii) Funding of research for searching for alternative or renewable energy sources (such as bio-gas, photo-electric, water-borne hydrogen fuel, etc.) has not received due emphasis despite their need and green nature. Even after the initial invention years or decades back, the speed and quantum of research have been low in these fields.

iii) Plastics cause huge environmental and human/animal health hazards throughout the planet (Pattanayak 2018b). The production of plastics causes the depletion of a huge amount of petroleum fuel and water. Many bio-degradable alternatives to plastics are available (such as jute-plastic, other bio-plastics, etc.) (Gill 2014, Pavel and Supinit 2017), but proper adaptive research for their production and widespread use is still lacking.

Even efforts are lacking to implement the technology already available to convert plastic waste to fuel (diesel, petrol, etc.) (Syamsiroa *et al.* 2014, Chanashetty *et al.* 2015, Karad and Havalammanavar 2017).

4. Intentional introduction of misleading technologies to create business opportunity

Numerous technologies are developed and advocated

in the name of betterment on living standards of the people. But many of these are not at all required and their widespread use may be detrimental. But once accustomed to them, people cannot think to leave them afterward.

i) Freshwater is scarce and invaluable. Irrational lifting or supply of groundwater in rural India for all household purposes in the name of supply of drinking water and their wastage may cause rapid depletion of groundwater even in the high rain-fed areas (Pattanayak 2015a).

Introduction of flush toilets replacing indigenous less water consuming practices, bathing and washing in the lifted groundwater replacing the pond, well, lake, river or canal water, etc. in thickly populated countries like India are some other examples (Pattanayak 2015a, Pattanayak 2016).

ii) Rapid depletion of natural forests and wastelands, use of groundwater in water-intensive agriculture in rural areas, and almost all household purposes of urban areas are threatening our sustainability and even future existence by inducing severe water crisis and many other serious problems like arsenic, fluoride, xenobiotic contaminations of drinking water, leaching and mixing of many synthetic organic and inorganic pollutants, saltwater intrusion in coastal areas and the crisis of potable water in different parts of the world. Depletion of potable or safe drinking water can only open and gear up the plastic bottled drinking water business across the globe causing more long-term harm (Pattanayak 2015a, Pattanayak 2015b, Pattanayak 2016).

Many cities like Chennai, Hyderabad, etc. are already reeling from potable water scarcity. Coastal cities such as Kolkata, Dhaka, Jakarta, Shanghai, etc. are experiencing saltwater intrusion in groundwater supplies (Pattanayak 2015b).

High incidences of cancers are found in the Bathinda district of Punjab, India. Heavy use of pesticides contaminating soil and groundwater is a likely cause of this (Thakur *et al.* 2008).

iii) Raising of high-rise flats in the urban and semi-urban areas for business purposes is performed at the cost of depletion of groundwater, loss of the top fertile soil of the agricultural fields to make bricks, and also losing many other important resources in the name of development, though many such flats remain unused.

iv) The widespread use of plastics for almost all household purposes may be considered unnecessary by logical analysis. But it is causing huge detrimental effects on the food chain, human or animal health, environment, and biosphere (Pattanayak 2018b). Though ample bio-degradable alternatives are available, for bottling of almost all drinks, carrying of almost all materials, in preparation of almost all household materials and water pipes, packing or keeping food materials, etc., plastics are used. We consume plastic additives and micro-plastics regularly from such sources.

Although regular intake of microplastics and plasticizers may be considered safe by the common people out of ignorance, scientists are concerned about their ill effects on humans, animals, and fish. It is already known that different plastic additives can act as some carcinogenic agents inside the human body (Brandt-Rauf *et al*. 2012, Pattanayak 2018b, Campanale *et al.* 2020).

Recently, different microplastics are found in human blood (Campanale *et al*. 2020, Leslie *et al*. 2022). Nobody tested the possibility of detrimental health impacts of these plastics before permitting their use, and nobody knows the long-term human health impacts of the absorbed microplastics. But the microplastics are already identified as some carcinogenic agents in some lower animals (Teles 2018).

v) The gathering of nuclear weapons and research on biological weapons has already caused huge detrimental effects and may even cause the abolition of the human race (Pattanayak 2021a). Even accidental leakage of bio-war agents can cause pandemic diseases or mass extinction of lives from our planet. Origin of the COVID-19 virus has been suspected from this angle.

5. Research performed for some vague purposes

Much of the so-called high funding research is performed to obtain some positive reports to introduce some questionable products in the market. These are sold then among the consumers by strong and continuous advertising pressure.

i) The anti-baldness medicines can stimulate the hair growth of a bald person. A large number of such medicines are available in the market.

ii) Hair oils can change the hair color or can increase hair growth, etc.

iii) The fairness creams can change the skin color and texture of a person.

Many irrelevant points are studied for the marketing of different cosmetics, but little importance is given to the toxicity study of the chemicals used in them (Hela *et al.* 2018).

6. Products used with unknown/unproven scientific basis

There are many food and healthcare products available in the market and used widely without any known study report on their actual efficacy.

i) The healthcare tonics, liver tonics, cough mixtures; digestive mixtures, etc. are used widely but with widely debated efficacy.

ii) Soft drinks containing sodium bicarbonate and dissolved carbon dioxide gas (converts to carbonic acid) are considered antacid and digestive!

iii) Some synthetic chemicals with or without traces of fruit pulp or juice are packed in plastic bottles, kept even directly under the sun for long periods, and chilled before use as some healthy fruit juices.

But no importance is given to the possible toxic effects of these chemicals along with leached plastics and their additives on our health even in their continuous use for years (Pattanayak 2019b).

7. Left areas for performing research

There are vital areas that require detailed study for benefit of the human race. But research in such areas is not taken up seriously, likely due to meager business benefits.

i) We are consuming varied synthetic chemicals every day and a portion of these toxins are perhaps gathered inside our body, but their cumulative effects on our health are still not studied (Pattanayak 2014, Pattanayak 2017b, Pattanayak 2021a).

ii) Different processed foods contain several chemicals and ingredients having the potential to cause serious harm to our health (Pattanayak 2017b). But information regarding their adverse effects is not available.

iii) Huge increase in the magnitude of the diseases like polycystic ovarian syndrome (PCOS), type 2 diabetes, cardiac diseases, chronic obstructive pulmonary disease (COPD) and other lung diseases, uterine fibroid, cholecystitis, urolithiasis, gastric ulcers, different types of hypersensitivity diseases, and above all - different types of cancer are generally attributed to some unknown reasons. Some of such diseases are marked as 'lifestyle diseases' and kept aside without seeking the link between specific 'lifestyle' with specific disease/s (Tabish 2017, Pattanayak 2019b).

The non-communicable diseases (NCD) cause a huge number of deaths in different countries, and in India, it is 61% of all deaths (Das *et al.* 2021).

iv) The industrial effluents and urban drain contents are not recycled and thrown in the canal or river without any treatment in many cases. These materials reach the sea after affecting the surrounding areas of the rivers or canals and ultimately enter the food chain of human and marine lives (Bhattacharya *et al.* 2014, Bhattacharya *et al.* 2016, Pattanayak 2021a). All are considered as some parts of development!

Are we performing ample research to know the actual impacts of all such materials on the biosphere as well as on our health?

8. The danger is known, but still advocated for use

Many gases and chemicals are advocated and advertised for widespread use perhaps to get more and more business profits, but their harmful effects are known to the scientific community. Many seminars are organized, and protocols are signed, but these fail to control the spread of the use of these materials.

i) CFC and HCFC gases

Chlorofluorocarbons (CFCs) are generally used in the manufacture of aerosol sprays, as some blowing agents for foams and packing materials, as solvents, and as refrigerants (UNEP OzoneAction prog 2001, Benhadid-Dib and Benzaoui 2012).

Hydro-chlorofluorocarbons (HCFCs) are used in refrigeration materials to bring cooling, in air conditioners, in foam blowing, as solvents in different chemical preparations, during the production of different aerosols, as a fire suppressing agent, etc. (UNEP OzoneAction Fact Sheet, Benhadid-Dib and Benzaoui 2012).

ii) Use of Halons

Halons are the members of organo-halogen compounds containing bromine and fluorine and one or two carbons. Halons are generally used as fire extinguishing agents and for different related purposes (UNEP DTIE OzonAction Programme 2001, MPSDOL 2007).

CFC, HCFC, and Halons are triggering the formation of holes in the ozone shield of our planet permitting entry of harmful ultraviolet rays which have been associated with skin cancer, eye diseases, etc. These greenhouse gases are also causing an increase in global temperature (UNEP DTIE OzonAction Programme 2001, MPSDOL 2007, Benhadid-Dib and Benzaoui 2012).

iii) Disposal of used batteries and e-wastes

Batteries are used to supply electricity to our modern gadgets. But these contain toxic metals like lead, mercury, cadmium, lithium, nickel, cobalt, chromium, etc. which have detrimental effects on our health as well as on the environment. But there is no plan for their scientific disposal after use and in many cases; these are directly thrown in the garbage box to reach the environment (Morrow 2001, Kang *et al.* 2013). Similarly, a vast amount of electronic wastes are generated every day and their effective disposal systems have not yet developed, causing serious impacts on health and the environment (Munialo and Collins 2020)!

9. Some other unknown or less known areas

i) Whether intake of Iodine with salt for decades irrespective of age or health status by the people residing at non - iodine-deficient soil has any negative impacts on health is unknown.

ii) Different growth promoters; production, and performance enhancers are used in meat-fish-egg producing sectors regularly. A part of these reaches us through their produce. The impact of residues of these materials on our health, although having research reports and instructions in some cases, is not strictly implemented. Common people are neither aware nor proper labeling of quality assurance on food items available in the markets.

iii) The cumulative effects of preservatives, stabilizers, coloring, flavoring agents, etc. in food items, chemicals used in drinks, medicines of synthetic origin, plastic additives, microplastics, other xenobiotic residues, etc. on our health is not studied properly - though these are regularly taken by the people (Pattanayak 2014, Pattanayak 2017b). Different adulterants and the synthetic materials used in the items like manufactured tea-dust or synthetic milk and milk products (like casein, butter, ghee, paneer, etc.) are some other added factors (Pattanayak 2014, Pattanayak 2017b, Pattanayak 2019a).

iv) In microwave heating, the molecular heating technique is used. Different food items are heated by keeping them in different pots before their use as some food. That may have some serious health impacts on our health, particularly from long-term intake of such microwave-cooked foods (El Ghazaly *et al.* 2014).

v) High concentration of Chlorine added in the municipal drinking water consumed by us regularly for years may have adverse effects on our health (Mohsen *et al.* 2019).

Many of these synthetic chemicals are experienced by our body for the first time throughout the entire evolutionary period. So, these are perhaps considered foreign to the body system and their adipose tissue accumulation and/or long-term effects may be a strong reason behind initiation as well as triggering many dangerous diseases, reasons of which are declared as not identified.

CONCLUSION

The simple lifestyle of rural people is fast-changing towards a complex and artificial urban life in the name of development, making life easy and comfortable, staying free from diseases, etc. The entire process has got momentum in the last few decades. But to supply these facilities, we are perhaps paying a huge cost. The time has come to calculate the actual cost and benefit of several aspects of development for the long-term sustainability of the human race, biodiversity, and ecosystems.

REFERENCES

Awosan K (2016) Knowledge of radiation hazards, radiation protection practices and clinical profile of health workers in a teaching hospital in Northern Nigeria. J Clinical Diagnostic Res 10. DOI: 10.7860/JCDR/2016/20398.8394.

Benhadid-Dib S, Ahmed Benzaoui A (2012) Refrigerants and their environmental impact substitution of hydro chlorofluorocarbon HCFC and HFC hydro fluorocarbon. Search for an adequate refrigerant. Energy Procedia 18: 807-816.

Bhattacharya S, Chattopadhyay A, Das AK, Mandal TK, Bandyopadhyay SK (2016) Lead contamination status in abiotic components and human hair around Bidhyadhari estuary of Indian Sundarban delta. Explor Anim Med Res 6(2): 150-158.

Bhattacharya S, Dubey SK, Dash JR, Das AK, Mandal TK, Bandyopadhyay SK (2014) Contamination status of cadmium in different biotic and abiotic components around the Bidhyadhari river of Indian Sundarban delta. Explor Anim Med Res 4(2): 158-171.

Bovine spongiform encephalopathy (BSE - Mad cow disease) fast fact (2008) The centre for food security and public health, Lowa state university, USA. https://www.cfsph.iastate.edu/FastFacts/pdfs/bse_F.pdf., downloaded on 03.10.2021.

Brandt-Rauf PW, Li Y, Long C, Monaco R, Kovvali G, Marion MJ (2012) Plastics and carcinogenesis: The example of vinyl chloride. J Carcinog 11: 5. DOI: 10.4103/1477-3163.93700.

Campanale C, Massarelli C, Savino I, Locaputo V, Uricchio VF (2020) A detailed review study on potential effects of microplastics and additives of concern on Human health. Intern J Enveron Res Pub Health 17(4): 1212. https://doi.org/10.3390/ijerph17041212.

Chanashetty VB, Patil BM (2015) Fuel from plastic waste. Intern J Emerging Technol (Spl Issue) 6(2): 121-128.

Chen Y, Jungsuwadee P, Vore M, Butterfield D, Clair D (2007) Collateral damage in cancer chemotherapy: oxidative stress in non-targeted tissues. Molecular Interventions. 7: 147-156. DOI: 10.1124/mi.7.3.6.

Das AK, Mohan V, Joshi S, Shah S, Zargar AH *et al*. (2021) IMPACT India: A novel approach for optimum diabetes care. J Diabetol 12: 239-245.

El Ghazaly NA, Radwan EH, El Gawad HSA, Kamel K, Barakat A (2014) Impact of microwave heated food on health. J Advances Biol 5(3): 703-720. DOI: https://doi.org/10.24297/jab.v5i3.5566.

Gill M (2014) Bioplastic: a better alternative to plastics. Intern J Res Applied Natural Social Sci 2(8): 113-118.

Halla N, Fernandes IP, Heleno SA, Costa P, Boucherit-Otmani Z *et al.* (2018) Cosmetics preservation: a review on present strategies. Molecules 23(1571): 1-41.

Kang DH, Chen M, Ogunseitan OA (2013) Potential environmental and human health impacts of rechargeable lithium batteries in electronic waste. Environ Sci Technol 47(10): 5495-5503. DOI: 10.1021/es400614y.

Karad RT, Havalammanavar S (2017) Waste plastic to fuel-petrol, diesel, kerosene. Intern J Engineering Dev Res 5(3): 641-645.

Leslie HA, van Velzen MJM, Brandsma SH, Vethaak AD, Garcia-Vallejo JJ, Lamoree MH (2022) Discovery and quantification of plastic particle pollution in human blood. *Environment International*, https://doi.org/10.1016/j.envint.2022.107199.

Mitra R, Pattanayak S (2018) Mobile phone and tower radiation: a challenge to all living entities. Explor Anim Med Res 8(1): 5-10.

Mohsen IH, Mohsen AH, Zaidan HK (2019) Health effects of chlorinated water: a review article. Pak J Biotechnol 16(3): 163-167. http://doi.org/10.34016/pjbt.2019.16.3.24.

Morrow H (2001) Environmental and human health impact assessments of battery systems. Industrial Chemistry Library 10: 1-34. https://doi.org/10.1016/S0926-9614(01)80003-4.

MPSDOL (2007) Montreal protocol on substances that deplete the ozone layer, UNEP, Halons Technical options committee. https://wedocs.unep.org/handle/20.500.11822/30030.

Munialo S, Collins O (2020) Impacts of electronic wastes on environment and human health. Intern J Scientific Engineering Res 11(5): 1174-1179.

OzonAction United Nations Environment Programme (UNEP) Fact Sheet, Division of Technology, Industry and Economics 1 rue Miollis, Building VII Paris 75015, France www.unep.org/ozonaction ozonaction@unep.org, downloaded on 21.10.2021.

Pattanayak S (2014) Cancer-the ultimatum of our chemical based civilization. Explor Anim Med Res 4(1): 5-7.

Pattanayak S (2015a) Wastage of underground water - steps towards a trap? Explor Anim Med Res 5(1): 7-9.

Pattanayak S (2015b) Incoming water crisis in India: as understood by others. Explor Anim Med Res 5(2): 117-119.

Pattanayak S (2016) Slow poisoning through water intake - are we conscious? Explor Anim Med Res 6(1): 5-7.

Pattanayak S (2017a) Alternative to antibiotics - preparation for post antibiotic era. Explor Anim Med Res 7(1): 05-10.

Pattanayak S (2017b) Processed foods – are they safe? Explor Anim Med Res 7(2): 125-131.

Pattanayak S (2018a) Alternative to antibiotics from herbal origin – outline of a comprehensive research project. Current Pharmacogenomics Personalized Medic. 2018; 16: 9-62. DOI: 10.2174/1875692116666180419154033.

Pattanayak S (2018b) Thrown plastics – cause of an incoming global disaster. Explor Anim Med Res 8(2): 133-139.

Pattanayak S (2019a) Trans-fats of processed and fried foods – a choice for taste or serious health problems? Explor Anim Med Res 9(1): 5-14.

Pattanayak S (2019b) Healthcare system using succulent parts of plants, Volume 2: Steps for production and marketing of some selected healthcare products. ISBN: 978-93-5391- 625-1.

Pattanayak S (2021a) Homo sapiens: Are the species making themselves extinct? Academia Letters. Article 1617. https://doi.org/10.20935/AL1617.

Pavel S, Supinit V (2017) Bangladesh invented bio-plastic jute poly bag and international market potentials. Open J Business Management 5: 624-640. DOI: 10.4236/ojbm.2017.54053.

Plackett B (2020) No money for new drugs. Nature Outlook 586: S 50- S 52. https://media.nature.com/original/magazine-assets/d41586-020-02884-3/d41586-020-02884-3.pdf.

Sabatini R, Cagiano R, Rabe TJ (2011) Adverse effects of hormonal contraception. Reproduktionsmed. Endokrinol 8 (Sonderheft 1): 130-156.

Shanbhag PS, Viswanath V, Torsekar RG (2006) Thalidomide: Current status. Indian J Dermatol Venereol Lepro 72: 75- 80.

Syamsiroa M, Saptoadib H , Norsujiantob T , Noviasria P, Chenga S *et al.* (2014) Fuel oil production from municipal plastic wastes in sequential pyrolysis and catalytic reforming reactors. Energy Procedia 47: 180-188.

Tabish SA (2017) Lifestyle diseases: consequences, characteristics, causes and control. J Cardiol Curr Res 9(3): 00326. DOI: 10.15406/jccr.2017.09.00326.

Teles M (2018) First time observation of genetic/ physiological damage caused by nanoplastics in mussels. Autonomous University of Barcelona, availability of https:// m.phys.org. Accessed on 01.11.2018.

Thakur JS, Rao BT, Rajwanshi A, Parwana HK, Kumar R (2008) Epidemiological study of high cancer among rural agricultural community of Punjab in Northern India. Int J Environ Res Public Health. 5(5): 399-407. DOI: 10.3390/ ijerph5050399.

USFDA Resources (2008) The effects of aspirin and acetaminophen on the stomach in healthy volunteers. Clinical trial gov. identifier: NCT00594867. University of Illinois at Chicago. Resource link provided by the National library of Medicine. https://clinicaltrials.gov/ct2/show/NCT00594867, downloaded on 04.10.2021.

UNEP DTIE OzonAction Programme (2001) Standards and codes of practice to eliminate dependency on halons. United Nations Publication. https://wedocs.unep.org/handle/ 20.500.11822/8787, downloaded on 23.10.2021.

***Cite this article as**: Pattanayak S (2022) Research targeting business profits: impacts on health and environment. Explor Anim Med Res 12 (1): 1-7. DOI: 10.52635/eamr/ 12.1.1-7.

Explor Anim Med Res,
Vol.11, Issue - 2, 2021, p. 140-144
DOI : 10.52635/eamr/11.2.140-144

ISSN 2277- 470X (Print), ISSN 2319-247X (Online)
Website: www.animalmedicalresearch.org

Editorial

PLANTS IN HEALTHCARE: PAST, PRESENT AND FUTURE

Shibabrata Pattanayak*

ABSTRACT: Plants have been used as medicines or sources of medicines from a very ancient stage of human civilization. In the ancient days, the collected plant parts were used directly or in dried and preserved conditions. Afterward, the dried parts of the medicinal plants were used as medicine as single or poly-herbal mixtures with or without vehicle as used in present-day Ayurveda and alike medical systems. In homeopathy, the ethanol extracts of dried plant parts are used. Identification of active principles from the extracts of the dried plant parts has made the basis of laboratory synthesis of many drugs of modern medicine. Some novel types of healthcare techniques are proposed for further validation. Following a diet containing selected herbal foods (DIP diet) in an unprocessed state along with a change in lifestyle can control many diseases. Fruit pulp, fruit juice and other related food products can be prepared by using only herbal plant parts and also can be supplied without the addition of any synthetic chemicals. Similarly, medicines prepared from the succulent parts of the medicinal plants can effectively be used to prevent and cure many diseases. All these can be performed following some novel procedures of collection, chemical-free processing, packaging, storage, and transportation to the patients and consumers.

Key words: Herbal medicine, Active principle, DIP diet, Succulent biomedicine.

HISTORY OF USE OF PLANTS AS MEDICINE

Plants have been used in healthcare from a very early stage of human civilization. The Neanderthals burial site (60000 years ago) (Solecki 1975), belongings of Ötzi the Iceman of 5000 years ago (Capasso 1998) etc. are some ancient examples where medicinal plant parts were found with the human. Among the written documents, the oldest one was found on a Sumerian clay slab of almost 5000 years old (Petrovska 2012). Other ancient pieces of evidence found were in the Chinese book "Pen TS'ao," written by Shen Nung of 2500 BC, in Egyptian Ebers Papyrus of 1550 BC (Petrovska 2012), Indian Ayurvedic medicine documented in the Vedas and Sushruta Samhita between 1500 – 500 BC (Aggarwal *et al.* 2007, Dwivedi and Dwivedi 2007), in Homer's epics - the Iliad and the Odysseys of 800 BC, in the works of Hippocrates of 459-370 BC, Dioscorides (considered as the father of Pharmacology) in his book "De Materia Medica of 77 AD (Petrovska 2012) etc.

On our planet, there are about 374,000 estimated plant species, of which 308,312 are vascular plants which include 295,383 flowering plants (Christenhusz and Byng 2016). India is among the leading biodiversity centers of the world for holding over 45,000 different plant species (Asthana *et al.* 2012). Out of 15000-17000 medicinal plants, about 3000 – 7500 species are used traditionally for medicinal purposes (Meena *et al.* 2009, Pattanayak 2012). Among the Indian traditional systems, Ayurveda (700), Unani (700), Siddha (600), and Amchi (600) are the main users of medicinal plants for therapeutic purposes (Rabe and Staden 1997). In Homeopathy, over 800 species of plants are used (Bharatan 2008).

The use of plants directly for medicinal purposes is not only a practice of the past. Even today, several ethnic and rural people use medicinal plants for their healthcare throughout the globe. As per WHO estimate, almost 80 percent of the world population depends mainly on traditional medicines, a large part of which is of herbal origin (Farnsworth 1985). The main reasons behind such widespread use of plant resources in healthcare are local availability and limited access to modern medicines (Pattanayak *et al.* 2012).

Assistant Director, ARD (Vet. Res. Invest.), Govt. of West Bengal, India and Associate Editor, Exploratory Animal and Medical Research.
**Corresponding author. e-mail: pattanayak1966@gmail.com*

RESEARCH ON THE USE OF PLANTS AS MEDICINE

A. Documentation of medicinal uses of plants

i) Documentation in the ancient era

During the ancient days, the use of the plants for different medicinal purposes was either not documented and the knowledge was passed for generations from the medicine men/women to their disciples or documented in some cases by local names (Sen and Sen 2005). With the passage of time, and with changes of the colloquial languages, such vernacular plant names have also changed. So, information about many important medicinal plants may have also been lost or not available now or the plant may also be extinct or non-identifiable at the present time (Sen and Sen 2005, Pattanayak 2012).

After the introduction of the scientific techniques of nomenclature for all the living species of our planet (plants, animals, etc.) by Carolus Linnaeus (1707 - 1778), the scientific nomenclature of the plants was started replacing local or colloquial names and the old or traditional uses of the plants are also documented afterward using these internationally accepted names (Pearson 2003).

Identification of actual plants from the ancient documented names and descriptions by analysis of different related points along with infield study of the said living plant species following scientific procedures and collection of information regarding their medicinal uses from the ancient texts and literature are very much important. Along with available documented ethnomedicinal reports, infield surveys to collect further information from the medicine men and medicine women as well as other rural people etc. made the platform of that study far more diverse and important.

ii) Recent trends in documentation

The early documentation works were performed either by plant Family-wise (as all the effective plants of a Family were listed with their reported uses) or individually without following any such system. In India, many early epic works of high significance have actually formed the basis for the works at a later stage (The wealth of India 1949, Chopra *et al.* 1956, Uphof 1968) and also a brief description of some selected important medicinal plants in the edited book by Ambasta (1986).

During the last few years, documentation of the use of medicinal plants as per their activity of a certain type has been observed. Plants used for the protection of some organ or organ-system are available to us from those pieces of literature (Pattanayak *et al.* 2016a, Pattanayak *et al.* 2016c, Nirumand *et al.* 2018). Reports on the use of medicinal plants in different geographical areas have also provided important information and enriched our knowledge base (Kutalek and Prinz 2005, Pattanayak *et al.* 2015a, Pattanayak *et al.* 2015b).

Another important type of cataloging of plants has been done based on possible medicinal activities of plants on the body systems by dietary use in their raw form to serve definite purposes. The use of the medicinal plants in a definite therapeutic purpose based on the systemic effects of all the nature-gifted phytochemicals inside them is the target of these studies. Such documentations are analytical in nature and can act as ready references for initiating research to validate their abilities as medicines. Use of plants against infectious diseases (Pattanayak 2019a, Khameneh *et al*. 2019, Pattanayak 2019b), as immunomodulators and body system-modifier to control different diseases (Pattanayak 2020, Pattanayak 2021), etc. are examples.

A. Contemporary research on medicinal activities of plants

i) Ayurveda and other similar systems of medicine

Ayurveda is considered the science of life with a holistic approach to health and personalized medicine. It is one of the oldest medicines containing thousands of medical concepts and hypotheses. Many people trust the ability of this system to treat different diseases such as cancer, asthma, diabetes, etc. which are not easily treatable in modern medicine (Chauhan *et al.* 2015).

Dry parts of the medicinal herbs singly or as polyherbal formulations are generally used in Ayurveda. The dry medicinal parts of the plants are generally converted to smaller parts and used with or without a vehicle, covered by capsules in a few cases (as soft gel capsules or hard capsules) in Ayurveda and many other similar traditional systems of medicines. In a few cases, some other type of uses of medicinal parts of plants is also practiced (such as decoction of herbal parts, use of essential oils, use of vapors etc.).

In the present day, research is mainly targeted to validate the activities documented in the various medical texts of Ayurveda and other similar systems in the eyes of modern science by using currently available research tools and techniques (Meena *et al.* 2009, Chauhan *et al.* 2015). So, research in Ayurveda is mainly targeted in the fields of collection of information from ancient literature, fundamental uses, understanding of the drugs as well as research on their pharmaceutical and clinical research activities (Chauhan *et al.* 2015).

ii) Homeopathy

In Homeopathy, alcoholic (ethyl alcohol generally) extracts of dry parts of medicinal plants at different levels of dilutions are generally used as medicines. Research on the collection of information and clinical trials is given much importance in Homeopathic medicine. The broad research activities in Homeopathy are - survey, collection, and cultivation of medicinal plants, standardization of drugs, proving of activities of the drugs, clinical verification of drugs, and clinical research on Homeopathic drugs (CCRH 2018).

iii) Modern medicine

In modern medicine, research is mainly conducted towards the development of marketable synthetic or semi-synthetic medicines using plants as some source (Pattanayak *et al.* 2016b).

For the development of a new drug, validation of traditional claims or other literature reports is performed as the first step. Different solvent (such as methyl alcohol, ethyl alcohol, acetone etc.) extracts of the dry parts of the medicinal plants are studied for their reported activities. If any fraction of the solvent extract shows the desired activity, studies are performed to identify the effective (active) principle(s) involved in such activity. Then further studies are conducted on laboratory synthesis of structural analogs of such active principles, determination of their dose and toxicity before marketing of the active drug as medicine (Pattanayak *et al.* 2016b, Pattanayak 2018, Khameneh *et al.* 2019).

B. Emerging windows of development of therapeutics from herbal origin

As a part of the modern lifestyle, people are becoming dependent more and more on processed foods and foods added with different synthetic chemicals. The cumulative effects of all such synthetic chemicals taken regularly may have serious impacts on our health (Pattanayak 2017). So, following an alternative to such dependence on the use of synthetic chemicals in food and medicine may reduce the bio-burden of chemicals and so the chance of development of several diseases.

Apart from the different contemporary systems of medicine involving the use of dry parts or their extracts of different nature to control and cure diseases, some new concepts are emerging in the area of use of plants as some biomedicines. Two main systems can be discussed under this category which are interrelated and may be considered as having relation with the Indian traditional healthcare system, Ayurveda. These two sections are advocated along with following the desired lifestyle involving ample daily physical exercise, restriction in some unhealthy activities, living without any narcotics or alcohol, following tension-free life etc. Among these two, one focuses on eating fruits, vegetables and nuts as a major part of the diet, eating of preservatives and all other added chemical-free fruit, fruit juice, ice cream, etc.; use of skincare, haircare, etc. preparations made solely from herbs without the addition of any synthetic chemicals, etc. The other one is the therapeutic use of parts of the medicinal plants at their succulent stages.

i) Novel concepts of use of unaltered herbal parts as food and healthcare

a) The DIP diets

"The disciplined and intelligent peoples' diet" (DIP diet) is mainly a plant-based diet plan with some protocols for breakfast, lunch, dinner etc. The fruits and nuts listed for use under this diet plan are to be taken in their raw, succulent form. It is claimed that people can stay away from diseases like high blood pressure, diabetes, thyroid problems, kidney diseases, arthritis, liver disease, cancers, obesity etc. by practicing this diet plan (Roy Chowdhury 2021).

A study was conducted on 55 diabetic persons kept on a selected raw fruit and vegetable diet for three days within some lifestyle restrictions. Among them, 84% of patients showed marked improvements, and 16% of patients showed moderate improvement in their blood glucose levels as a result of the diet and lifestyle modifications (Roy Chowdhury 2017).

b) Use of fruit products, herb made skin-hair care products, etc. without any synthetic chemical

A novel collection, packaging and transportation system are proposed for fruit pulp, fruit juices, other related products like fruit ice creams; skincare, hair care products, etc. of completely herbal origin. Following the described procedures, medicinal parts of the plants are to be collected, encapsulated, or packed without the use of any synthetic chemicals (like synthetic preservatives, stabilizers, etc.) and can be transported throughout the globe under a framed cold chain system (Pattanayak 2019b).

ii) Succulent biomedicines

The term succulent biomedicine is given to the paste, juice, or seed-powder of relevant parts of different medicinal plants collected as well as used in the succulent state. In this novel system of medicine, uses of synthetic chemicals are avoided at all the steps of preparation, encapsulation, packaging, storage and transportation of

the medicines. This system is framed with some defined steps. After validation of their activities in succulent forms, the medicinal plant parts are to be collected in their succulent conditions from the area of their cultivation. Then after standardization of dose and performing toxicity studies, these can be mixed with bio-preservatives and then may be capsulated by bio-encapsulating materials, if required. Finally these are to be transported to patients throughout the globe and can be stored by the retailers under some specially designed cold chain facilities (Pattanayak 2020, Pattanayak 2021). As the succulent parts of the medicinal plants contain almost all the phytoconstituents present in the living plants, it is natural that they can show the highest level of activities in that form. In all other systems of medicine where the dry parts of the plants or their extracts are used have the limitation of presentation of only one or a few phytochemicals of the medicinal plant parts (Pattanayak *et al.* 2016b).

CONCLUSION

Plants and animals are two important entities of nature. Most animal species take plants as part of their diet. Many of the ape species take parts of plants for health benefits. The ancient people perhaps had a similar type of habit. But possibly due to problems in the storage of succulent plant parts and only seasonal or regional availability of fresh plants forced our predecessor to depend on the dried parts of the medicinal plants. Afterward, many systems were developed depending on the use of only the dry parts of the medicinal plants as medicines.

As the problem of preservation is not relevant at the present time and since many important phytochemicals are either reduced or lost in the dried or processed fruits, roots, or vegetable items, adoptive researches should be initiated for effective dietary use of succulent foods and succulent biomedicines. This can only lead to the development of different branches of the system, standardization of all related parameters, the establishment of herb-based medicine industries, and widespread application of the system for the benefit of mankind.

REFERENCES

Aggarwal BB, Sundaram C, Malani N, Ichikawa H (2007) Curcumin: The Indian solid gold (https://archive.org/details/moleculartargets00bhar). Adv Exp Med Biol 595: 1-75.

Ambasta SP (1986). The useful plants of India. National Institute of Science Communication and Information Resources. CSIR, New Delhi.

Asthana A, Kumar A, Gangwar S, Dora J (2012) Pharmacological perspectives of *Cynodon dactylon*. Res J Pharmaceut Biol Chem Sci 3(2): 1135-1147.

Bharatan V (2008) Homeopathy and systematics: a systematic analysis of the therapeutic effects of the plant species used in homeopathy. Homeopathy 97(3): 122-128. DOI: 10.1016/j.homp.2008.04.002.

Capasso L (1998) 5300 years ago, the Ice Man used natural laxatives and antibiotics. Lancet 352(9143): 1864. DOI:10.1016/S0140-6736(05)79939-6.

CCRH - Central Council for Research in Homoeopathy (2018) Ministry of AYUSH, Govt. of India. https://www.ccrhindia.nic.in/index1. aspx?lsid =61&lev= 2&lid=59&Regid=0&langid=1.

Chauhan A, Semwal DK, Mishra SP, Semwal RB (2015) Ayurvedic research and methodology: Present status and future strategies. Ayu 36(4): 364-369. DOI:10.4103/0974-8520.190699.

Chopra RN, Nayar SL, Chopra IC, Asolkar LV, Kakkar KK (1956) Glossary of Indian medicinal plants. Council of Scientific and Industrial Research, New Delhi, India.

Christenhusz MJM, Byng JW (2016) The number of known plants species in the world and its annual increase. Phytotaxa 261(3): 201-217. DOI:10.1007/978-0-387-46401-5_1.

Dwivedi G, Dwivedi S (2007) History of Medicine: Sushruta-the clinician-teacher par excellence. Indian J Chest Dis Allied Sci 49: 243-244.

Farnsworth, Norman R, Akerele, Olayiwola, Bingel *et al.* (1985) Medicinal plants in therapy. Bulletin of the World Health Organization, 63(ý6)ý: 965-981. https://apps.who.int/iris/handle/10665/265180. [Accessed on 17.08.2021].

Khameneh B, Iranshahy M, Soheili V, Bazzaz BSF (2019) Review on plant antimicrobials: a mechanistic viewpoint. Antimicrobial Resistance Infection Control 8: 118. https://doi.org/10.1186/s13756-019-0559-6.

Kutalek R, Prinz R (2005) African medicinal plants. In: Yaniv Z, Bachrach U. Handbook of medicinal plants, The Haworth Medical Press, New York, USA.

Meena AK, Bansal P, Kumar S (2009) Plants-herbal wealth as a potential source of ayurvedic drugs. Asian J Traditional Medic 4(4): 152-170.

Nirumand MC, Hajialyani M, Rahimi R, Farzaei MH, Zingue S *et al.* (2018) Dietary plants for the prevention and management of kidney stones: preclinical and clinical evidence and molecular

mechanisms. Int J Mol Sci 19: 765. DOI:10.3390/ijms19030765.

Pattanayak S, Dutta MK, Debnath PK, Bandyopadhyay SK, Saha B, Maity D (2012) A study on ethno-medicinal use of some commonly available plants for wound healing and related activities in three southern districts of West Bengal, India. Explor Anim Med Res 2(2): 97-110.

Pattanayak S, Mandal TK, Bandyopadhyay SK (2015a) Plants used to cure problems of flatulence and constipation in three southern districts of West Bengal, India. Explor Anim Med Res 5(2): 142-151.

Pattanayak S, Mandal TK, Bandyopadhyay SK (2015b) A study on use of plants to cure enteritis and dysentery in three southern districts of West Bengal, India. J Medic Plants Studies 3(5): 277-283.

Pattanayak S, Mandal TK, Bandyopadhyay SK (2016a) Ethno-gynaecological study of the medicinal plants traditionally used in southern districts of West Bengal, India. Indian J Traditional Knowledge 15(3): 482-486.

Pattanayak S, Mandal TK, Bandyopadhyay SK (2016b) Validation and therapeutic use of succulent plant parts - opening of a new horizon of alternative medicine. Explor Anim Med Res 6(1): 8-14.

Pattanayak S, Mandal TK, Bandyopadhyay SK (2016c) Ethnomedicinal study of plants used for protection and stimulation of liver in southern West Bengal, India. Explor Anim Med Res 6(2): 164-178.

Pattanayak S (2017) Processed foods – are they safe? Explor Anim Med Res 7(2): 125-131.

Pattanayak S (2018) Alternative to antibiotics from herbal origin – outline of a comprehensive research project. Current Pharmacogenomic Personalised Medic 16(1): 9 -62. DOI: 10.2174/1875692116666180419154033.

Pattanayak S (2019a) Healthcare system using succulent parts of plants, Volume I: For infectious diseases. ISBN: 978-93-5346-842-2.

Pattanayak S (2019b) Healthcare system using succulent parts of plants, Volume 2: Steps for production and marketing of some selected healthcare products. ISBN: 978-93-5391-625-1.

Pattanayak S (2020) Succulent biomedicines - an effective way of getting protection against diseases through immunomodulation. Explor Anim Med Res 10(2): 112-123.

Pattanayak S (2021) Anti-COVID-19 biomedicines - a layout proposal for production, storage and transportation. The Open COVID J 1: 166-188. DOI: 10.2174/2666958702101010166.

Pearson H (2003) 250 years of Linnaeus' plant names celebrated. Nature 2003, https://doi.org/10.1038/news030825-7.

Petrovska BB (2012) Historical review of medicinal plants' usage. Pharmacognosy Rev 6(11): 1-5. DOI:10.4103/0973-7847.95849.

Rabe, Staden JV (1997) Antibacterial activity of South African plants used for medicinal purposes. J Ethnopharmacol 56: 81; Cited in: Meena AK, Bansal P, Kumar S (2009) Plants-herbal wealth as a potential source of ayurvedic drugs. Asian J Traditional Medic 4(4): 152-170.

Roy Chowdhury B (2017) Diabetes reversal by plant-based diet. J Metabolic Synd 6(4): 1000232. DOI: 10.4172/2167-0943.1000232.

Roy Chowdhury B (2021) DIP diet plan, https://dipdiet.in/wp-content/uploads/2021/06/Dip-Diet-Plan-1.pdf

Sen U, Sen D (2005) Ayurveda Sar Samgraha (Bengali edn.). Swami Santadas Institute of Culture, Kolkata, India.

Solecki RS (1975) Shanidar IV, a Neanderthal flower burial in Northern Iraq. Science 190 (4217): 880-881. [Bibcode: 1975Sci. 190.880S doi:10.1126/science.190.4217.880; S2CID 71625677], downloaded 01.08.2021.

The wealth of India: A dictionary of Indian raw materials and industrial products (Industrial products-part I) (1949). Ind Med Gaz 84(10): 476-477.

Uphof JCT (1968) Useful species: Dictionary of economic plants. 2 nd. edn. Cramer, Wiirzburg, Stechert-Hafner, New York.

***Cite this article as:** Pattanayak S (2021) Plants in healthcare: past, present and future. Explor Anim Med Res 11(2): 140-144. DOI: 10.52635/eamr11.2.140-144.

Explor Anim Med Res,
Vol.10, Issue - 2, 2020, p. 97-99

ISSN 2277- 470X (Print), ISSN 2319-247X (Online)
Website: www.animalmedicalresearch.org

Editorial

DIETARY MODULATION WITH FATTY ACIDS: A POTENTIAL WAY TO OVERCOME COVID-19

Novel coronavirus (SARS-CoV-2) infection or the so called COVID-19 has created a global crisis killing lakhs of people so far and crippling every sphere of human activity such as economy, education, social life, etc. The virus is extremely infectious and causes illness with diverse signs and symptoms affecting several body parts, notably brain, lungs, digestive system, cardio-vascular system, kidney, etc. Very few viral infections have such a wide spectrum of tissue tropism and clinical signs, despite its low fatality rate of only about 2.7% (WHO 2020). A key feature is the relatively high morbidity and mortality among the greying and aged population.Type 2 diabetes, hypertension, cardiovascular diseases which are now frequently common among global populations are major comorbidities of the disease. Another cause of concern is the prolong recovery period - COVID-19 survivors may suffer from extreme weakness and sudden collapse, impaired/reduced cognition, lack of energy, etc. for very long period extending for months or even more.

The virus uses the ACE2 receptor protein for attachment and cell entry which is widely distributed throughout the body and found in high levels in lungs, kidney etc. making these organs highly prone to virus-induced changes and failure. A sudden onset of cytokine storm and intravascular micro-coagulations in vital organs are the immediate causes of death in COVID-9. Intensive researches across the globe are now unrevealing metabolic modulations of host cells as the primary mechanism of the virus pathogenesis. SARS-CoV-2, unlike some other common human viruses such as influenza A (H_1N_1) virus and respiratory syncytial virus, cause widespread metabolic reprogramming for its own benefits which is possibly the cause of diverse clinical signs and prolonged recovery period (Ehrlich *et al.* 2020). Plasma metabolomic study also indicated altered carbohydrate, protein and lipid metabolism, and in particular decreased levels of malic acid, D-xylulose 5-phosphate and carbamoyl phosphate in COVID-19 patients (Wu *et al.* 2020).

SARS-CoV-2 disrupts glucose oxidation

Among several clinic-pathological changes, dysregulated sugar metabolism, expressed as persistent hyperglycaemia, and onset of diabetes among non-diabetics suggest that glucose metabolism is highly perturbed (Codo *et al.* 2020). Hyperglycaemia has been linked to over-secretion of proinflammatory cytokine IL-6 leading to cytokine burst and multiple organ failure. *In vitro* experiment also showed that high glucose level increases the viral load and expressions of ACE2, IL-1β, IL-6, TNF-α, and IFN α, β, and λ in CoV-2-infected monocytes in a concentration-dependent manner favouring the viral infection and outcome. The virus also promotes T cell dysfunction and pulmonary dysfunction encountered in severe COVID-19 cases (Codo *et al.* 2020).

The virus causes mitochondrial elongations, altered TCA cycle, glycolysis and pentose phosphate pathways, besides alteration of protein and lipid metabolism, favouring nucleotide and lipid synthesis for virus replication. However, among the whole plethora of metabolic alterations, dysregulation of sugar metabolism, especially glycolysis is the most prominent. Metabolomic study of lung tissue also shows uncoupling of TCA cycle and oxidative phosphorylation, and upregulation of anaerobic glycolysis: the virus upregulates glycolysis and hijacks the energy pathways for its replication (Ehrlich *et al.* 2020). Uncoupling of cellular respiration cause oxidative stress which is again linked to severity of the infection. The over-activated glycolysis may also be correlated with many folds increase in serum lactate dehydrogenase enzyme (LDH) levels in severely affected and terminal patients (Henry *et al.* 2020). SARS-CoV-2 inhibits the pyruvate dehydrogenase complex forcing body into energy crisis and cytokine burst.

Glucose is the major energy source of body, especially in brain, lungs, kidney, etc. and altered glycolysis and energy generation pathways affect functioning of these organs. Since glucose enters metabolism/energy generation pathways through glycolysis altered dehydrogenases and diverting glycolysis for synthesis of virus molecule and thus depriving body of energy is likely to affect body for long term. This is a likely reason of extreme weakness and long recovery period among the

COVID-19 survivors. Further, glucose oxidation by body decreases with age. The low level of glycolysis activity might predispose one to severe COVID-19 infection in old age.

Fatty acids as a saviour

Since the virus inhibits dehydrogenases and hijacks glycolysis-driven energy pathway, carbohydrate-based diet is supposed to enhance the disease severity. Unlike glucose, fatty acids and amino acids do not enter the TCA cycle through glycolysis. Further, level of glucose utilization in elderly and diabetic individuals are low. Hence enhancing cell metabolism other than of sugars may control virus growth and provide energy to the cells for survival and mounting of interferon and other innate immune responses at the cell level. Although transcriptomic and metabolomic studies show that the virus also alters lipid metabolism, there are inconsistent observations on the effect of virus on lipid metabolism. Unlike enhanced blood glucose levels, concentrations of blood lipids decrease with severity of the infection and are inversely correlated with IL-6 levels (Wei *et al.* 2020). Metabolomic study indicated that the virus alters lipid metabolism with higher levels of triglycerides and cholesterol in COVID-19 patients. Since cholesterol is essential for virus synthesis and release, use of cholesterol synthesis inhibitors such as statins has been suggested against the virus (Abu-Farha *et al.* 2020).

From published literatures it seems that aberration in lipid and protein metabolism is low as compared to the sugar metabolism in COVID-19. When glycolysis is unable to provide energy in COVID-19, it is essential that body must oxidise fat and proteins for energy generation. Drugs like fenofibrate and oleoylethanolamide which stimulate fatty acid oxidation have also been proposed as a promising treatment of the disease (Ghaffari *et al*. 2020). High-fat diet and/or exogenous ketone supplementation have been suggested to provide energy essential for every cell and prevent cytokine burst (Bradshaw *et al.* 2020). Further, omega-3 fatty acids are known to have anti-inflammatory properties and thus foods rich in these PUFA might provide energy as well as protection against inflammatory reactions (Calder 2020). However, the virus triggers lipogenesis for envelop synthesis and use of more fat during active stage of the infection might enhance the disease severity (El-Kurdi and Khatua 2020). Thus, instead of using fat during acute stage, fatty foods might prime body to oxidize fat for energy during healthy state and may favour faster recovery as well.

Besides above functions, binding of unsaturated fatty acids such as linoleic acid, etc. to surface spike glycoproteins of enveloped viruses including SARS-CoV-2 destabilizes their structural integrity and reduces virus interactions with ACE2 receptor proteins leading to reduced virus infection (Toelzer *et al.* 2020). Dietary fatty acids have also been suggested as a possible way to reduce inflammatory changes in lungs, intestine, etc. in COVID-19 conditions (Calder 2020, Onishi *et al.* 2020).

It is expected that taking enough fat and protein rich food might save a life and enhance recovery. Hence nutritious foods rich in minerals, vitamins and especially those rich in unsaturated fatty acids have been suggested to prevent the COVID-19 (Calder 2020, Onishi *et al.* 2020). The global population will have to live with the virus for long till vaccines are made available to the huge susceptible population. Till then let the fatty foods rich in MUFA and omega-3 rich fatty acids such as fish, the potent vegetable oils, nuts, fruits, and milk be our weapons to fight against the virus.

Tapan Kumar Mandal[1], Shibabrata Pattanayak[2]

[1]Editor-in-Chief, Exploratory Animal and Medical Research
[2]Associate Editor, Exploratory Animal and Medical Research

REFERENCES

Abu-Farha M, Thanaraj TA, Qaddoumi MG, Hashem A, Abubaker J *et al.* (2020) The role of lipid metabolism in COVID-19 virus infection and as a drug target. Int J Mol Sci *et al.* 21: 3544.

Bradshaw PC, Seeds WA, Miller AC, Mahajan VR, Curtis WM (2020) COVID-19: Proposing a ketone-based metabolic therapy as a treatment to blunt the cytokine storm. Oxid Med Cell Longev 2020: 6401341.

Calder PC (2020) Nutrition, immunity and COVID-19. BMJ Nutr Prev Health 2020(3): 000085.

Codo AC, Davanzo GG, Monteiro LB, de Souza GF, Muraro SP *et al.* (2020) Elevated glucose lvelsfavor SARS-CoV-2 infection and monocyte response through a HIF-1α/glycolysis-dependent axis. Cell Metab 32(3): 437-446.

Ehrlich A, Uhl S, Ioannidis K, Hofree M, Oever BR, Yaakov N (2020) The SARS-CoV-2 transcriptional metabolic signature in lung epithelium. https://ssrn.com/abstract=3650499.

El-Kurdi B, Khatua B (2020) Mortality from coronavirus disease 2019 increases with unsaturated fat and may be reduced by early calcium and albumin supplementation. Gastroenterology 159: 1015-1018.

Ghaffari S, Roshanravan N, Tutunchi H, Ostadrahimi A, Pouraghaei M *et al*. (2020) Oleoylethanolamide, a bioactive lipid amide, as a promising treatment strategy for coronavirus/ COVID-19. Arch Med Res 51: 464-467.

Henry BM, Aggarwal G, Wong J, Benoit S, Vikse J *et al.* (2020) Lactate dehydrogenase levels predict coronavirus disease 2019 (COVID-19) severity and mortality: a pooled analysis. Am J Emerg Med 38: 1722-1726.

Onishi JC, Haggblom MM, Shapses SA (2020) Can dietary fatty acids affect the COVID-19 infection outcome in vulnerable populations? mBio 11(4): e01723-20.

Smith SM, Boppana A, Traupman JA, Unson E, Maddock DA *et al.* (2020) Impaired glucose metabolism in patients with diabetes, prediabetes and obesity is associated with severe Covid-19. J Med Virol 26:10.1002/jmv26227.

Toelzer C, Gupta K, Yadav SKN, Borucu U, Davidson AD *et al*. (2020) Free fatty acid binding pocket in the locked structure of SARS-CoV-2 spike protein. Science 370(6517): 725-730.

Wei X, Wenjuan W, Su J, Wan H, Yu X *et al*. (2020) Hypolipidemia is associated with the severity of COVID-19. J Clin Lipid 14: 297-304.

WHO (2020) https://covid19.who.int/ accessed 31 Oct. 2020.

Wu D, Shu T, Yang X, Song J-X, Zhang M *et al*. (2020) Plasma metabolomic and lipidomic alterations associated with COVID-19. Natl Sci Rev 7: 1157-1168.

Cite this article as: Mandal TK, Pattanayak S (2020) Dietary modulation with fatty acids: a potential way to overcome COVID-19. Explor Anim Med Res 10(2): 97-99.

Explor Anim Med Res,
Vol.9, Issue - 1, 2019, p. 5-14

ISSN 2277- 470X (Print), ISSN 2319-247X (Online)
Website: www.animalmedicalresearch.org

Editorial

TRANS-FATS OF PROCESSED AND FRIED FOODS – A CHOICE FOR TASTE OR SERIOUS HEALTH PROBLEMS?

During last a few decades, scientists are reporting about detrimental health effects of saturated fats – the fats stay solid at room temperature. But from the research performed during last a few years, it appears that the saturated fats are dwarf in comparison to the detrimental health effects incurred through intake of Trans fats.

Fats in our diet and their effects

Fats serve as a major source of energy. Fats are generally hydrophobic, insoluble in water and are soluble in organic solvents. They serve many important structural and metabolic functions of the body. They are the most energy dense nutrients and so a necessary part of our diet. Fats help in absorption of some vitamins and minerals in the gut, which is very important. They are needed to build cell membranes and the sheaths surrounding nerves. Fats are also essential for many important physiological functions like blood clotting, muscle movement etc. (Harvard 2018).

Fat includes Glycerol and Fatty acids. Glycerol is made up of three carbon atoms. One of those bonds is made with a hydroxyl-group. Fatty acids have a long chain of carbons. On one end of the chain there is a carboxyl-group (Zundel, Study.com).

The difference of one fat to another is the length and shape of the carbon chain and the number of hydrogen atoms connected to the carbon atoms. Slight differences in structure of fat molecules can bring crucial differences in their form and function (Harvard 2018).

According to the chemical structure as well as effects on our health, the fats can be categorized as Saturated, Mono-unsaturated, Poly-unsaturated and Trans fats (Am Heart Assoc, Dilatory fats 2014).

Saturated fats

Saturated fats are the fat molecules that have no double bonds between carbon molecules as all of them are saturated with hydrogen molecules. So, the fatty acid chains of saturated fats have all or predominantly single bonds (-C-C-). Saturated fats are generally remained solid at room temperature (Zundel, Study.com).

Source: Most of the animal fats are saturated in nature. Fats present in beef, lamb, pork, poultry, tallow (separated beef fat), lard (separated pork fat), cream, butter, cheese etc. are all saturated in nature. Palm oil, palm kernel oil, coconut oil etc. plant-based oils also contain high percentage of saturated fats (Am Heart Assoc, Saturated fat 2015).

Many processed foods, baked goods and fried foods are prepared with saturated fats and so automatically rich in saturated fats (Am Heart Assoc, Saturated fat 2015). A diet rich in saturated fats can drive up total cholesterol, increase more the harmful or bad Low-Density Lipoprotein (LDL) cholesterol along with a little good High-Density Lipoprotein (HDL) cholesterol.

Many years of epidemiological research have shown that populations consuming diets high in saturated fatty acids show relatively high levels of serum cholesterol and carry a high prevalence of coronary heart disease (Caggiula and Mustad 1997). The LDL cholesterol can cause formation of blockages in the arteries of the heart and elsewhere in the body (Harvard 2018).

Many guidelines are released by many medical organizations, including the World Health Organization, advocating reduction of saturated fat intake to promote health and to reduce the risk from cardiovascular diseases. Many researchers also recommend a diet very low in saturated fat to lower the risks of cardiovascular diseases (Hooper *et al.* 2015), diabetes, or death (Sacks *et al.* 2017).

Unsaturated fats

Most of the fats obtained from plants and fishes are unsaturated in nature (US Dept of Agril 2015).

Mono-unsaturated fats

Monounsaturated fats have only one (mono) carbon-to-carbon double bond (-C=C-). It means that these fats have only one unsaturated double bond (of *cis* type) in the fatty acid chain with all of the remainder carbon atoms is having single bonds (Am Heart Assoc, Monounsaturated fat 2015).

Oils that contain monounsaturated fats are typically liquid at room temperature but start to turn solid when

chilled (Am Heart Assoc, Monounsaturated fat 2015).

The discovery of the fact that monounsaturated fats could be helpful to our health came from the Seven Countries Study during the 1960s. It revealed from the study that people of Greece and other parts of the Mediterranean region showed very low rate of heart disease despite taking high fat rich diet. The main fat in their diet was Olive oil which contains mainly monounsaturated fat (Harvard 2018).

Monounsaturated fats can help to reduce the level of bad (LDL) cholesterol in the blood and so can lower the risk of heart disease and stroke. They can also provide nutrients to help develop and maintain the body cells. Oils rich in monounsaturated fats can also add vitamin E to the diet, which act as an antioxidant (Am Heart Assoc, Monounsaturated fat 2015).

Good sources of monounsaturated fats are olive oil, peanut oil, canola oil, avocados, most nuts, as well as high-oleic sunflower oil and sesame oil (Am Heart Assoc, Monounsaturated fat 2015; Harvard 2018).

Poly unsaturated fats

Polyunsaturated fatty acids have two or more double bonds in their carbon chain. There are two main types of polyunsaturated fatty acids: omega-3 fatty acids and omega-6 fatty acids. The numbers (3 or 6) refer to the distance between the beginning of the carbon chain and the first double bond. Both of these types of fatty acids offer different health benefits. Poly unsaturated fats having the tendency to remain liquid at room temperature with varying degrees of viscosity (Harvard 2018).

Polyunsaturated fats are required to build cell membranes and the covering of nerves. They are also required for blood clotting, muscle movement and inflammation (Harvard 2018).

Omega-3 fatty acids

Omega-3 fatty acids may prevent and even can treat heart diseases and stroke. These can reduce blood pressure, raise HDL, lower the level of triglycerides and can prevent lethal heart rhythms from arising. As per some research reports, they may help to reduce the need for corticosteroid medications in people with rheumatoid arthritis. Omega-3 fats are perhaps linked with a wide range of other health improvements including reducing risk of dementia according to a systematic review of the Agency for Healthcare Research and Quality (Harvard 2018).

Sources

Alpha Linolenic acid (ALA): Flaxseeds, walnuts and their oils are among the richest dietary sources of ALA. Canola oil is also an excellent source of it (Table 1).

Eicosapentaenoic acid (EPA) and docosahexaenoic acid (DHA): Oily fish are the major dietary source of them. Humans can synthesize EPA and DHA from ALA (Oregon State Unv 2014).

Omega-6 fatty acids

Linoleic acid and other omega-6 fatty acids can act to protect us from heart diseases. Vegetable oils such as safflower, soybean, sunflower, walnut and corn oils are rich in omega-6 fatty acids (Table 1) (Harvard 2018).

Source

Linoleic acid: Food sources of Linoleic acid include vegetable oils like soybean, safflower, and corn oil; many nuts, seeds and also some vegetables.

Arachidonic acid: Only animals can convert Linoleic acid to Arachidonic acid in their body system. For this reason, Arachidonic acid is present in meat, poultry, and eggs in small amounts.

So, humans can also synthesize Arachidonic acid from Linoleic acid (Oregon State Unv 2014).

The *Cis* and *Trans* bonds

These are the nomenclature of typical bonding type of hydrogen with carbon. All bonding of Mono unsaturated fatty acids is of *cis* type. Generally, the bonds of poly unsaturated fatty acids are also of *cis* type. The *trans* type bonds are found naturally in a few cases and artificially in some situations.

In the *cis* fatty acids, the two parts of fatty acid molecules are on the same side of the double bonds, *i.e*, functional groups are on the same side. In the *trans* form, two parts of fatty acid molecules are on opposite sides of double bonds (CSPINET 2004). So, the fat may exists as *cis* or *trans* isomers depending on the geometry of the double bond.

The trans fats

Trans fats, also called trans-unsaturated fatty acids or trans fatty acids, are a type of unsaturated fatty acids that occur in small amounts in nature (Trans fat taskforce report of Canada 2006), but widely produced industrially as a bi product (CSPINET 2004).

Formation of Trans fats

Trans fats are created following two main ways.

Naturally occurring trans fats

Some trans fats are made by bacteria that live in the fore-stomach (rumen) of cattle, sheep, goats, deer etc.,

So, such trans fats may occur naturally in animal meats like beef, mutton, chevon etc. as well as in dairy products like milk, cheese, butter and cream (Saxelby 2018). These foods contain trans fats at very small quantities (Am Heart Assoc, Trans fat 2017).

Artificially produced trans fats

A. Partial hydrogenation of unsaturated vegetable oils.

Artificial trans fats are created in an industrial process that adds additional hydrogen to liquid vegetable oils (unsaturated fats) to make them solid saturated fats (Am Heart Assoc, Trans-fat 2017). For this, the oil is heated in the presence of hydrogen and a catalyst (hydrogen is bubbled through them by force in the presence of a catalyst) to transform them into solid and semi-solid fats (Saxelby 2018). Theoretically, all double-bonds of the oils should be converted to single bonds and all the unsaturated fats should be converted to saturated fats in full hydrogenation. But generally incomplete or partial hydrogenation is performed. In such partial hydrogenation, only some double-bonds are converted into single bonds. As a side effect of the partial hydrogenation process, some of the *cis* double-bonds are converted into *trans* double-bonds, resulting in trans fatty acids (CSPINET 2004).

So, due to change of molecular structure of fatty acids, 30 to 60 percent of bonds become trans type. The trans fats are the chemically opposite of the usual cis form (Saxelby 2018). Thus, the healthful unsaturated oils are converted into some harmful semisolid fats for our action.

Most trans-fats are monounsaturated (one double bond) fatty acid. The shape of trans-fat molecules is more like cholesterol-raising saturated fat than a typical monounsaturated fatty acid. Perhaps for that reason, it increases cholesterol levels in blood (CSPINET 2004).

The trans fatty acid content of industrially hydrogenated fats varies widely and may account for up to 60% of the fatty acid content, whereas the trans fatty acid content of fats of animal source (natural) is considerably lower and accounts for 2%–5% of the total fatty acid content (Weggemans *et al.* 2004).

So, the primary dietary source for trans fats in processed foods is the partially hydrogenated oils (Am Heart Assoc, Trans-fat 2017).

B. Refining of vegetable oils

Edible oils are refined to remove certain impurities or naturally present materials (free fatty acids, phospholipids, carbohydrates, proteins and/or their degradation by-products). Removal of these materials is required to get

Fig. 1. Foods deep fried in Vanaspati, a popular choice of Indians.

desired color, taste and aroma of the oils (Nawar 1996).

The vegetable oils are generally heated between 60 ^{0}C and 100 ^{0}C before deodorization to improve organoleptic characteristics of the oils. During that deodorization process, the temperature is generally raised up to 180 ^{0}C to 270 ^{0}C. That level of heating leads to the formation of trans fatty acids in the vegetable oils (Martin *et al.* 2007).

C. Frying

Frying at some very high temperatures is the main basis of preparation of most of the processed and fried foods. During such deep frying (150 ^{0}C–190 ^{0}C or more), the hot oil acts as the heat transfer medium and contributes to the texture and flavor of the fried foods (Bouchon 2009). During this process, the edible oils or fats undergo various chemical reactions (Goyal and Sundararaj 2009).

The oil qualities of these fried foods were analyzed by Fourier transform infrared (FTIR) spectroscopy. Loss of cis double bonds along with an increase in trans double bonds was observed in these studies (Goburdhun *et al.* 2001), thus confirming the formation of trans fatty acids during such high temperature heating of oils.

Many trans fatty acids can be formed during reusing the oil many times under high temperature (Liu *et al.* 2007).

Reasons for creation and use of trans fats

The solid or semisolid hydrogenated fats are easy to use, inexpensive to produce and last for a long time. These fats give the processed and fried foods a desirable taste and texture. Many restaurants and fast-food outlets use these fats to deep-fry foods because oils with trans fats can be used many times in commercial

fryers (Am Heart Assoc, Trans-fat 2017). So, partially hydrogenated oils have been used to replace butter, lard, palm oil, coconut oil and other hard (saturated) fats in many deep fried and processed foods (CSPINET 2004).

Trans fat containing food

According to the Food and Drug Administration (FDA), we consumed about 5.6 grams of trans fat per day during 1994-96. Most of those trans-fats came from the 40,000-plus foods that contain partially hydrogenated vegetable oil (CSPINET 2004).

All the food or food items prepared with hydrogenated vegetable oils contains trans fats. The list includes margarines, all biscuits, pastries, cookies, crackers, icings (CSPINET 2004); cakes, ice cream, bread (www.diabetes.co.uk, Trans fats); movie-popcorn (popcorn fried in hydrogenated fats available in movie halls), potato crisps, corn chips, sausage rolls, meat pies, French fries, chips, wedges, battered fish, nuggets, spring rolls, crumbed chicken, fish fingers, Danish pastries, croissants, snails and apple pies (Saxelby 2018); pizza, coffee creamer and all deep-fried foods at restaurants (CSPINET 2004). So, almost all snack foods, packaged baked goods and frying fast foods contain trans fats (CSPINET 2004).

Effects of trans fats on health

Cardiovascular diseases

1. High levels of serum cholesterol have a strong relation with high prevalence of heart diseases (Caggiula and Mustad 1997). High level of serum cholesterol, particularly LDL cholesterol can promote the development of atherosclerosis or coronary heart disease (Mensink and Katan1990).

Trans fatty acid consumption raises the Low-Density and Very Low Density (LDL and VLDL) cholesterol levels as well as lowers the level of High Density (HDL) cholesterol. It also leads to reduced triglyceride uptake and production of free fatty acids (Mozaffarian 2006). All these factors may cause heart diseases.

Even a very small amount of trans fats can be harmful to our health. For every 2% of calories from trans fat consumed daily, the risk of heart disease rises by 23% (Harvard 2018).

Evidence suggests that trans fats perhaps increase the risk of coronary heart disease about two-and-a-half times the heart disease risk of saturated fats (Hu *et al.*1997).

2. Trans fatty acids increase the levels of Lp (a) lipoprotein and reduce the LDL cholesterol, particle size of which further heightens the risk of coronary heart diseases. There are several other mechanisms through which trans fats may stimulate both lipid and non-lipid risk factors for cardio- vascular diseases (Mozaffarian 2006).

3. Trans fats promote systemic inflammation by increasing the levels of C-reactive protein (CRP) leading to thickening of the arteries which may lead to sudden death due to cardiac failure (Mozaffarian *et al.* 2004, Lopez 2005).

4. Trans fatty acids cause endothelial dysfunction by increasing circulating bio-markers including soluble inter cellular adhesion molecule -1, soluble vascular-cell adhesion molecule -1 and E-selectin (Lopez 2005). Endothelial dysfunction is a key step in the development of atherosclerosis (Mozaffarian *et al.* 2004).

Type 2 Diabetes

Trans fats create inflammation, which is also linked with diabetes and other chronic conditions. They contribute to insulin resistance, which increases the risk of developing type 2 diabetes (Harvard 2018).

It was observed that the risk of the development of type-II diabetes is associated with intake of trans fatty acid in a study of 14 years. It was observed that for 2% increase in energy from trans fatty acids can increase the relative risk of type 2 diabetes to a very high level. If that trans fats are replaced by poly-unsaturated fats, the risk of Type 2 diabetes will reduce 40% (Salmeron *et al.* 2001).

Studies carried out at National Institute of Nutrition (NIN), Hyderabad, India to evaluate the effects of trans fatty acids of Vanaspati (commonly used hydrogenated vegetable oil in India, usually made by hydrogenation of Palm oil) showed that both of the saturated fatty acids (10% energy) and trans fatty acids (3% energy) increased insulin resistance. However, the effects of trans fats were greater than saturated fats in increasing insulin resistance in rats (Ghafoorunissa 2008).

Increase of C reactive protein due to trans-fat intake may also lead to diabetes (Mozaffarian *et al.* 2004). Trans fats have shown to increase insulin resistance and seem to have a unique cardio-metabolic imprint that is linked to insulin-resistance and metabolic-syndrome pathways (Mozaffarian 2006).

Effect on pregnancy and newborn babies

An association was found between high intake of trans fatty acids and the risk of pre-eclampsia (pregnancy induced hypertension). In the study, trans fatty acid intake was estimated by the trans fatty acid content of the cell

Table 1. Composition of different commonly used vegetable oils (in %).

Name	Saturated fatty acids	Poly Unsaturated fatty acids			Mono Unsaturated fatty acids
		Omega 6 fatty acids	Omega 3 fatty acid (Alpha Linolenic Acid)	Total	
#Almond oil	8.2	17.4	0	17.4	70
#Apricot Kernel oil	6.3	29.3	0	29.3	60
#Avocado oil	11.56	12.53	1	13.53	70.56
#Canola oil	7.1	20.3	9.3	29.6	58.6
#Coconut oil	86.5	1.8	0	1.8	5.8
#Corn oil	13.17	53.52	1.16	54.68	27.47
#Cottonseed oil	25.8	51.6	0.2	51.8	17.8
#Flaxseed (Linseed) oil	9.4	12.7	53.3	66	20.2
#Grape-seed oil	9.5	69.6	0.1	69.7	16.1
#Hazelnut oil	7.3	10.1	0	10.1	78
#Mustard oil	6.26	15.33	5.9	21.23	59.2
#Oat oil	18.35	39.08	1.79	40.87	35.1
#Olive oil	13.46	9.21	0.79	10	73.9
#Walnut oil	9.0	52.9	10.4	63.3	22.7
#Pea nut (Ground nut) oil	16.9	32	0	32	46.2
#Rice Bran oil	19.2	33.4	1.6	35	39.3
#Safflower oil	6.21	74.6	0	74.6	14.36
^Palm oil	49.9	10.1	0.4	10.5	39.2
^Palm Kernel oil	82.1	2.4	0	2.4	15.4
*Wheat germ oil	26.1	53.0	4.68	57.68	16.2
*Sesame oil	16.4	41.8	0.51	42.3	41.4
*Pumpkin oil	20.2	54.7	0.43	55.1	24.7
*Argan oil	19.2	34.6	0.39	35.0	45.8
*Sunflower oil	8.65 (up to 18)	37.8 (up to 69)	0.28	38.1	53.2 (up to 82)[$]
*Soybean oil	13.5	54	8.3	62.3	24.5

Cordain (thepaleodiet.com.). ^ Mancini *et al.* (2015), * Rueda *et al.* (2014).

[$]The concentration of different types of fatty acids may vary for the factors like breed of plant producing oil seeds. High linoleic, high oleic, mid oleic and high stearic Sunflower oils are made available through designed plant breeding and industrial processing.
[$]The compositions of fresh oils are shown. For deep frying or hydrogenation, the composition may be changed.
[$]The Omega 6 and Omega 3 fatty acids are essential fatty acids for us.
[$]Some other types of fats of negligible amount are also present in the oil seeds.

walls of red blood cells. It was noticed that women who developed pre-eclampsia had approximately 30% higher trans fatty acid levels in red blood cells than women who did not develop this disorder (Yli-Jama *et al.* 2002). Trans fats may have relation with shortening of pregnancy period also (Dhaka *et al.* 2011). Consumption of trans fatty acids has shown to increase the risk for ovulatory infertility in women (Chavarro 2007).

Studies on humans have shown that trans fatty acids are transferred to the foetus, as they were found in the same levels in the blood of mothers and new born infants (Berghaus *et al.* 1998, Elias and Innis 2001).

Trans fats can compromise the development of the fetus. There is a significant negative relationship between birth weight and a trans fat (trans-9) concentration in maternal plasma phospholipids during early stages of pregnancy (Hornstra 2006). Trans fats may have adverse effects on growth and development through interfering with essential fatty acid metabolism, direct effects on membrane structures or metabolism, or secondary to reducing the intake of the cis essential fatty acids either in the mother or the child (Innis 2006).

Cancer

The adipose concentration of trans fats showed a positive association with breast cancer, not attributable to differences in age, body mass index, exogenous hormone used or socio-economic status (Kohlmeier *et al.* 1997, Dhaka *et al.* 2011).

Trans fat may cause colon cancer (Dhaka *et al.* 2011).

Obesity

Obesity research indicates that trans-fat may increase weight gain and abdominal fat deposits (Ricerus *et al.* 2002, Dhaka *et al.* 2011).

Allergy

The incidence of asthma, allergic cold and asthmatic eczema in children aged 13–14 years was investigated in some selected centres around the world. A positive association was found between the intake of trans fatty acids and these diseases (Weiland *et al.* 1999). Such observations were noted by Dhaka *et al.* (2011). But such an association was not observed for the intake of monounsaturated and polyunsaturated fatty acids (Willett *et al.* 1993).

Other health effects

Trans fatty acids can cause disorders of nervous system and vision in infants (Dhaka *et al.* 2011). It can cause Alzheimers and may be a potential cause of liver dysfunction (www.diabetes.co.uk, Trans fats).

As the hydrogenation process destroys some of the vitamin K in vegetable oils, which might be a problem for consumers who have marginal intakes of that vitamin (CSPINET 2004).

Evidences have shown that higher intake of saturated and trans-fat since midlife and lower polyunsaturated to saturated fat ratio are associated with a faster rate of cognitive decline and it also might be associated with neurodegenerative diseases (Morris *et al.* 2004).

Trans fats - cause of death

Harvard researchers estimate that trans fats cause up to 228,000 cases of heart disease annually (Kloss 2018). Both WHO and researchers of Harvard University estimates that trans fats may be the cause of death of 50,000 people per year (Saxelby 2018, Kloss 2018).

Effects of trans fats: natural vs synthesized

The good news is that there is no evidence of detrimental health effect performed by the natural forms of trans fats (Saxelby 2018). Instead, it is reported that these natural trans fats provide health benefits (Bassett *et al.* 2010, Gebauer *et al.* 2011).

Dilatory intake limit of fats

WHO recommended a limit up to 1% and 10% of energy in diet to be derived from trans fatty acids and saturated fatty acids, respectively (Dhaka *et al.* 2011). If we need to lower our blood cholesterol, we have to limit use of the saturated fat not more than 5 to 6 percent of total calories. For someone eating 2,000 calories a day, that is about 13 grams of saturated fat (Am Heart Asso, Saturated fat 2015).

In November 2013, the U.S. Food and Drug Administration (FDA) made a preliminary determination that partially hydrogenated oils are no longer Generally Recognized as Safe (GRAS) in human food (Am Heart Assoc, Trans fat 2017).

Boiling and repeated boiling of oils – some study reports

Deep frying of fat at 180 °C or above is one of the most common food processing methods used for preparing of processed foods worldwide. A series of complex reactions such as oxidation, hydrolysis, isomerization and polymerization take place during the deep-fat frying course and they influence quality attributes of the final product such as flavour, appearance, taste, shelf life and nutrient composition (Goyal and Sundararaj 2009, Zhang et al. 2012). The influence of these reactions results from a number of their products including volatile compounds, hydrolysis products, oxidized triacylglycerol monomers, cyclic compounds, trans configuration compounds, polymers, sterol derivatives, nitrogen- and sulphur-containing heterocyclic compounds, acrylamide, etc. which are present in both frying oil and the fried foods (Zhang *et al.* 2012).

In Wistar rats treated with the repeatedly heated cooking oil revealed higher peroxide value in comparison to oil that has been unheated or singly heated. Histo-pathological observation depicted significant damage in

jejunum, colon and liver of animals that received oil heated repeatedly for 3 times. The altered antioxidant status reflects an adaptive response to oxidative stress (Venkata and Subramanyam 2016).

Trans fatty acids were estimated in six commonly used fat/oils in India (refined soybean oil, groundnut oil, olive oil, rapeseed oil, clarified butter, partially hydrogenated vegetable oil), before and after subjecting them to heating/frying at 180 °C and 220 °C. All six fats/oils subjected to heating/frying demonstrated an increase in trans fatty acids, saturated fatty acids and decrease in cis unsaturated fatty acids (Bhardwaj *et al.* 2016).

The Indian condition

In India, the street restaurants, hotels, festive food suppliers, sweet shops etc. use saturated fats and hydrogenated fats with repeated boiling at some very high temperatures (Fig. 1) (Pattanayak 2014). Deep fried items are famous everywhere in India, but the deep black coloured oil generally used in that purpose is loosely sold and having very doubtful source and quality (Pattanayak 2017).

The trans fats are added in the processed foods in India due to some reasons. Partially hydrogenated vegetable fats (Vanaspati/margarine) can replace naturally solid, saturated fatty acids (Ghee, butter etc.). Hydrogenated fats are preferred in commercial food processing as they are economical, allow a longer shelf life and give desirable taste, texture and shape (Agarwal *et al.* 2008). It is used in Indian cooking and in the preparation of commercially fried, processed, bakery, ready-to-eat and street foods (Ghafoorunissa 2008), sweet preparation (Agarwal *et al.* 2008) etc. Trans fats in biscuits and sweets range 30-40 and 6-26% of total fatty acids respectively (Ghafoorunissa 2008).

The main hydrogenated vegetable oils used in India are Vanaspati and Dalda, both are very rich in trans fats. Vanaspati provides up to 40% trans-fat (Ghafoorunissa 2008). It is the main source of trans fatty acid in Indian food items. Vanaspati accounts for 10% of total production of edible oils, with a maximum consumption of 20 g/person/day in north India (Ghafoorunissa 2008).

Trans fats are present in all fast foods, bakery items, all biscuits, sweets, chocolates, spreads, soups, salad dressings and snacks sold in India. The trend of eating out in the urban population and consumption of food in hotels and restaurants can be considered unhealthy as the food prepared there is very high in trans fats (Dhaka *et al.* 2011).

In India, there is no system to monitor and regulate the amount of trans fats in processed foods and hence a stringent food law is immediately required (Dhaka *et al.* 2011). But there is no such regulation on trans fatty acids content in vanaspati, bakery fats and shortenings (Ghafoorunissa 2008).

Practically, the level of consciousness of Indians about effect of saturated fats and trans fats is perhaps far away from creation of any such pressure to get any legislative control.

The alternatives

For industry

In light of the research findings, provisions should be there to bring down trans fatty acid intake to zero and new technology of hydrogenation of oils is to be developed for that purpose. At the same time, efforts should be there to preserve the desirable properties contributed by trans fatty acids to the hydrogenated oils (Dhaka *et al.* 2011).

For personal safety

The best way is to stop intake of any food having trans fat completely. Following steps may be followed for that purpose.

1. Use of oils such as olive and sunflower oils instead of margarine and butter during cooking or other purposes may be a better option. For instance, when baking a cake, a recipe that works well using oil instead of solid fats may be adopted.
2. Avoiding of margarine or butter in the dish.
3. Avoiding purchase of commercial cakes, slices, biscuits, muffins, quiches and pies. Instead, baking of such foods at home using oils may be performed.
4. Avoiding eating of pastry, including shortcrust and puff.
5. Avoiding of all deep-fried fast foods (Saxelby 2018).

Other important points

1. Most oils are high in monounsaturated or polyunsaturated fats and low in saturated fats. Oils from plant sources (vegetable and nut oils) do not contain any cholesterol. In fact, no plant foods contain cholesterol (US Dept Agril 2015).
2. Some fats remain almost solid in room temperature due to huge saturated fat content. Beef fat (tallow, suet), chicken fat, pork fat (lard), butter etc. are example. These may be avoided.
3. Oils like coconut oil, palm oil, palm kernel oil etc. are high in saturated fats and for nutritional purposes should be considered to be solid fats (US Dept Agril 2015) and

so may be avoided.

So, it can be said that mono unsaturated fats are best, poly unsaturated fats are acceptable with calculation of Omega 3 fatty acids and Omega 6 fatty acids, saturated fats are bad and trans fats are almost poisonous to our health.

To stay away from some very serious health effects, we must have to reduce the intake of saturated fats drastically and to delete trans fats from our diet totally.

Table 1 shows composition of different commonly used vegetable oils, which may assist us to choose the proper oils for our cooking or use in other diatory preparations. Use of a few good oils may be a better option than use of single oil continuously for getting different essential fatty acids and other beneficial ingredients from them.

Shibabrata Pattanayak
Associate Editor,
Exploratory Animal and Medical Research

ACKNOWLEDGEMENT: The author is thankful to Mr. Sandipan Das, M.Sc. B.Ed., Assistant teacher, Panchkahania Higher Secondary School, Paschim Medinipur, West Bengal for the assistance rendered by him.

REFERENCES

Agrawal A, Gupta R, Varma K, Mathur B (2008) High trans fatty acid content in common Indian fast foods. Nutr Food Sci 38(6): 564-569.

American Heart association. Dilatory fats (2014) https://www.heart.org/en/healthy-living/healthy-eating/eat-smart/fats/dietary-fats. Accessed on 05.03.19.

American Heart association. Mono-unsaturated fat (2015) https://www.heart.org/en/healthy-living/healthy-eating/eat-smart/fats/monounsaturated-fats. Accessed on 15.03.19.

American Heart association. Saturated fat (2015) https://www.heart.org/en/healthy-living/healthy-eating/eat-smart/fats/saturated-fats. Accessed on 05.03.19.

American Heart association. *Trans* fats (2017) https://www.heart.org/en/healthy-living/healthy-eating/eat-smart/fats/trans-fat. Accessed on 02.04.2019.

Bassett CMC, Edel AL, Patenaude AF, McCullough RS, Blackwood DP *et al*. (2010) Dietary vaccenic acid has antiatherogenic effects in $LDLr^{-/-}$ mice. J Nutrition 140(1): 18-24.

Berghaus TM, Demmelmair H, Koletzko B (1998) Fatty acid composition of lipid classes in maternal and cord plasma at birth. Eur J Pediatr 157: 763-768.

Bhardwaj S, JainPassi S, Misra A, Pant KK, Anwar K *et al*. (2016) Effect of heating/reheating of fats/oils, as used by Asian Indians, on *trans* fatty acid formation. Food Chemistry 212: 663-670.

Bouchon P (2009) Understanding oil absorption during deep-fat frying. Adv Food Nutr Res 57: 209-234.

Caggiula AW, Mustad VA (1997) Effects of dietary fat and fatty acids on coronary artery disease risk and total and lipoprotein cholesterol concentrations: epidemiologic studies. Am J Clin Nutr 65: 1597S-1610S.

Center for Science in the Public Interest (CSPINET) (2004). About trans fat and partially hydrogenated oils. https://cspinet.org/resource/qa-about-trans-fat-and-partially-hydrogenated-oils. Accessed on 10.03.19.

Chavarro JE, Rich-Edwards JW, Rosner BA, Willett WC (2007) Dietary fatty acid intakes and the risk of ovulatory infertility. Am J Clin Nutr 85(1): 231-237.

Cordain L. Vegetable oil fatty acid composition. https://thepaleodiet.com/vegetable-oil-fatty-acid-composition/ Accessed on 15.04.2019

Dhaka V, Gulia N, Ahlawat KS, Khatkar BS (2011) Trans fats-sources, health risks and alternative approach - a review. J Food Sci Technol 48(5): 534-541.

Elias SL, Innis SM (2001) Infant plasma trans, n-6, and n-3 fatty acids and conjugated linoleic acids are related to maternal plasma fatty acids, length of gestation, and birth weight and length. Am J Clin Nutr 73: 807-814.

Gebauer SK, Chardigny JM, Jakobsen MU, Lamarche B, Lock AL *et al*. (2011) Effects of ruminant trans fatty acids on cardiovascular disease and cancer: a comprehensive review of epidemiological, clinical and mechanistic studies. Adv Nutr 2: 332-354.

Ghafoorunissa G (2008) Role of trans fatty acids in health and challenges to their reduction in Indian foods. Asia Pac J Clin Nutr 17: 212-215.

Goburdhun D, Jhaumeer-Laulloo SB, Musruck R (2001) Evaluation of soybean oil quality during conventional frying by FTIR and some chemical indexes. Int J Food Sci Nutr 52(1): 31-42. Cited in Bhardwaj S, JainPassi S, Misra A (2011) Overview of trans fatty acids: biochemistry and health effects. Diabete Metabol Synd Clinic Res Rev 5: 161-164.

Goyal N, Sundararaj P (2009) Are we unknowingly consuming trans fats and abused oils? Bull Nutr Found India 30(2): 4-7. Cited in Bhardwaj S, JainPassi S, Misra A (2011) Overview of trans fatty acids: biochemistry and health effects. Diabete Metabol Synd Clinic Res Rev 5: 161-164.

Harvard health publishing (2018) Harvard Medical School. The truth about fats: the good, the bad, and the in-between. www.health.harvard.edu/staying-healthy/the-truth-about-fats-bad-and-good.

Hooper L, Martin N, Abdelhamid A, Davey Smith G (2015) Reduction in saturated fat intake for cardiovascular disease. Cochrane Database of Systematic Rev 10 (6): 1-109.

Hornstra G, Van Eijsden M, Dirix C, Bonsel G (2006) Trans fatty acids and birth outcome: some first results of the MEFAB and ABCD cohorts. Atheroscler Suppl 7(2): 21-23. Cited in: Mueller A, Thijs C, Rist L, Simoes-Wust AP, Huber M *et al.* (2010) Trans fatty acids in human milk are an indicator of different maternal dietary sources containing trans fatty acids. Lipids 45: 245-251.

Hu FB, Stampfer MJ, Manson JE, Rimm E, Colditz GA *et al.* (1997) Dietary fat intake and the risk of coronary heart disease in women. New England J Medic 337 (21): 1491-1499.

Innis SM (2006) Trans fatty intakes during pregnancy, infancy and early childhood. Atheroscler Suppl 7(2): 17-20.

Kloss K (2018) 10 Shocking foods that sneak in trans fats. Reader's Digest. https://www.rd.com/health/healthy-eating/trans-fat-foods/. Accessed on 01.04.19.

Kohlmeier L, Simonsen N, van 't Veer P, Strain JJ, Martin-Moreno JM *et al.* (1997) Adipose tissue trans fatty acids and breast cancer in the European community multicenter study on antioxidants, myocardial infarction, and breast cancer. Cancer Epidemiol Biomark Prev 6(9): 705-710.

Liu WH, Stephen Inbaraj B, Chen BH (2007) Analysis and formation of trans fatty acids in hydrogenated soyabean oil during heating. Food Chem 104(4):1740-1749. Cited in: Dhaka V, Gulia N, Ahlawat KS, Khatkar BS (2011) Trans fats-sources, health risks and alternative approach - a review. J Food Sci Technol 48(5): 534-541.

Lopez GE, Schulze MB, Meigs JB, Manson JE, Rifai N *et al.* (2005) Consumption of trans fatty acids is related to plasma biomarkers of inflammation and endothelial dysfunction. J Nutr 135(3): 562-566.

Mancini A, Imperlini E, Nigro E, Montagnese C, Daniele A *et al.* (2015) Biological and nutritional properties of Palm oil and Palmitic acid: effects on health. Molecules 20: 17339-17361.

Martin CA, Milinsk MC, Visentainer JV, Matsushita M, De-Souza NE (2007) Trans fatty acid-forming processes in foods: a review. An Acad Bras Cienc 79(2): 343-350.

Mensink RP, Katan MB (1990) Effect of dietary trans fatty acids on high-density and low-density lipoprotein cholesterol levels in healthy subjects. N Engl J Med 323: 439-445.

Morris MC, Evans DA, Bienias JL, Tangney CC, Wilson RS (2004) Dietary fat intake and 6-year cognitive change in an older biracial community population. Neurology 62(9): 1573-1579.

Mozaffarian D, Rimm EB, King IB, Lawler RL, McDonald GB, Levy WC (2004) Trans fatty acids and systemic inflammation in heart failure. Am J Clin Nutr 80(6): 1521-1525.

Mozaffarian D, Katan MB, Ascherio A, Stampfer MJ, Willett WC (2006) Trans fatty acids and cardiovascular disease. N Engl J Med 354(15): 1601-1613.

Nawar WW (1996) Lipids. In: Fenema OR, editor. Food chemistry. New York: Marcel Dekker. Cited in Bhardwaj S, JainPassi S, Misra A (2011) Overview of trans fatty acids: biochemistry and health effects. Diabet Metabol Syndr Clinic l Res Rev 5: 161-164.

Oregon State University, Micronutrient information centre (2014) Essential fatty acids. https://lpi.oregonstate.edu/mic/other-nutrients/essential-fatty-acids. Accessed on 12.03.19.

Pattanayak S (2014) Cancer – the ultimatum of our chemical based civilization. Explor Anim Med Res 4(1): 5-7.

Pattanayak S (2017) Processed foods – are they safe? Explor Anim Med Res 7(2): 125-131.

Ricerus U, Arner P, Brismar K, Vessby B (2002) Treatment with dietary trans 10 - cis 12 conjugated linoleic acid causes isomer specific insulin resistance in obese men with the metabolic syndrome. Diabetes Care 25: 1516-1521.

Rueda A, Seiquer I, Olalla M, Giménez R, Lara L *et al.* (2014) Characterization of fatty acid profile of Argan oil and other ddible vegetable oils by Gas Chromatography and Discriminant Analysis. J Chemist 2014: 1- 8.

Sacks FM, Lichtenstein AH, Wu JH, Appel LJ, Creager MA *et al.* (2017). Dietary fats and cardiovascular disease: a presidential advisory from the American Heart Association. Circulation 136 (3): e1–e23.

Salmeron J, Hu FB, Manson JE, Stampfer MJ, Colditz GA *et al.* (2001) Dietary fat intake and risk of type II diabetes in women. Am J Clin Nutr 73: 1019-1026.

Saxelby C (2018) 13 trans-fat foods to remove from your diet! https://foodwatch.com.au/blog/fats-and-oils/item/13-trans-fat-foods-to-remove-from-your-diet.html. Accessed on 17.04.2019.

Trans Fat Task Force of Health Canada and Heart and Stroke Foundation of Canada (2006). "TRANSforming the Food Supply" https://www.canada.ca/content/dam/hc-sc/migration/hc-sc/fn-an/alt_formats/hpfb-dgpsa/pdf/nutrition/tf-gt_rep-rap-eng.pdf. Accessed on 12.03.2019.

Trans fats. https://www.diabetes.co.uk/food/trans-fats.html. Accessed on 12.03.19.

US Department of Agriculture (2015) What are oils? (https://web.archive.org/web/20150609080528/http://www.choosemyplate.gov/food-groups/oils.html). Accessed on 15.03.19.

Venkata RP, Subramanyam R (2016) Evaluation of the deleterious health effects of consumption of repeatedly heated vegetable oil. Toxicol Reports 3: 636-643.

Weggemans RM, Rudrum M, Trautwein EA (2004) Intake of ruminant versus industrial trans fatty acids and risk of coronary heart disease - what is the evidence? Eur J Lipid Sci Technol 106: 390-397.

Weiland SK, von Mutius E, Hüsing A, Asher MI (1999) On behalf of the ISAAC steering committee. Intake of trans fatty acids and prevalence of childhood asthma and allergies in Europe. Lancet 353: 2040-2041. Cited in Dhaka V, Gulia N, Ahlawat KS, Khatkar BS (2011) Trans fats-sources, health risks and alternative approach - a review. J Food Sci Technol 48(5): 534-541.

Willett WC, Stampfer MJ, Manson JE, Colditz GA, Speizer FE *et al.* (1993) Intake of trans fatty acids and risk of coronary heart disease among women. Lancet 341: 581-585. Cited in Dhaka V, Gulia N, Ahlawat KS, Khatkar BS (2011) Trans fats-sources, health risks and alternative approach - a review. J Food Sci Technol 48(5): 534-541.

Yli-Jama P, Meyer HE, Ringstad J, Pedersen JI (2002) Serum free fatty acid pattern and risk of myocardial infarction: a case-control study. J Intern Med 251: 19-28.

Zhang Q, Saleh ASM, Chen J, Shen Q (2012) Chemical alterations taken place during deep-fat frying based on certain reaction products: a review. Chemist Physic Lipids 165(6): 662-681.

Zundel J. What are fats? - functions and molecular structure. https://study.com/academy/lesson/what-are-fats-functions-molecular-structure-quiz.html.

***Cite this article as:** Pattanayak S (2019) Trans-fats of processed and fried foods – a choice for taste or serious health problems? Explor Anim Med res 9(1): 5-14.

Explor Anim Med Res,
Vol.8, Issue - 2, 2018, p. 133-139

ISSN 2277- 470X (Print), ISSN 2319-247X (Online)
Website: www.animalmedicalresearch.org

Editorial

THROWN PLASTICS – CAUSE OF AN INCOMING GLOBAL DISASTER

All of us use different types of plastics every day. Many of us use several plastic carry bags regularly during marketing and after reaching home, we usually discard them. A huge quantity of plastic is used as packaging material just to attract us. The plastic packets, dishes, water bottles, foams and most of the other plastics are used only for single time. We do not bother about any appeal of the Government or any other bodies to control the use of plastics. Due to such casual approach, our entire civilization is perhaps approaching towards extinction.

Besides the radioactive waste produced by atomic plants and carbon monoxide, carbon dioxide and some other dangerous gases emitted due to the burning of hydrocarbon fuel, the next threat to our civilization is from the continuous deposition of non-biodegradable plastics on the surface of the earth. The land, the sea surface, the sea bottom, the mountain valleys, the poles - no region is now devoid of plastics (Pattanayak 2007).

Plastic : a very popular item

The benefits of plastic are undeniable. Plastics are cheap, lightweight and easy to give required shape. These qualities have led to a boom in the production of plastic over the past century (UNEP 2018).

Qualities like good gas and moisture barrier properties, high heat and chemical resistance, opacity, toughness, transparency, solvent resistance, waxy surface, strong tough and flexible nature etc. are attributed to different types of plastics.

Plastic packaging accounts for about half of the plastic waste in the world. Most of this waste is generated in Asia, while America, Japan and the European Union are the world's largest producers of plastic packaging waste per capita (UNEP 2018).

Production of plastics

Plastics are petroleum-based products. These are produced in various forms. The basic principle of production of plastic is the conversion of natural gas or crude oil components into monomers like ethylene, propylene, butane, styrene etc. in presence of catalysts. Then, the monomers are chemically bonded to a chain termed as polymer. Different combinations of monomers along with different additives (Chlorine, Nitrogen, Fluorine, Oxygen etc.) and color materials are used to prepare different types of plastics (Pattanayak 2007).

Type of plastics and their use

There are many types of plastics. Among them, polyethylene is the form of plastic that is used for production of polythene bags. Many kinds of polyethylene can be made from ethylene. The commonly used plastic bags are made from one of three basic types: high-density polyethylene (HDPE), low-density polyethylene (LDPE), or linear low-density polyethylene (LLDPE). The low-density polyethylene (LDPE) form of plastic is used to prepare common plastic carry bags and also used in packaging of frozen foods, fruit juices and milk cartons etc. High-density polyethylene (HDPE) is generally used for production of buckets, bowls, cups, plates, packets for cement and fertilizers, large sized bottles. It is also used in making milk containers, detergent bottles, refrigerators, toys, various types of plastic grocery bags etc.

Poly vinyl chloride (PVC) is used for production of Rexene, shoe soles, toys, pipes, tubing, blood and plasma transfusion bags etc. Polycarbonate (PC) is used to produce baby feeding bottles, large water bottles etc. The thermo set poly urethane (P.U.) is used to produce all types of foams. Polypropylenes (PP) are used to prepare packaging materials for edible items, luggage carrier and textile cones. Polyethylene terephthalate (PET) is used to prepare bottles for many purposes (Pattanayak 2007).

Plastic additives

Plastic additives are some chemicals used to add certain properties to the plastics. The main plastic additives are Bisphenol A, Phthalates, Brominated Flame Retardants and some Heavy Metals.

Handling of plastic as waste

Our ability to handle plastic waste effectively is already overwhelmed. Only nine per cent of the nine billion tons of plastic the world has ever produced have been recycled. Most ends up in landfills, dumps or in the environment. If current consumption patterns and waste management practices continue, then by 2050 there will be around 12 billion tons of plastic litter in landfills and the environment (UNEP 2018).

Toxicity of plastics

Direct toxic effects of plastics:

During production and use

All types of plastic require a huge amount of mineral oil for their production and transportation. As estimated, if the growth of plastic production continues at its current rate, then the plastic industry may account for 20 per cent of the world's total oil consumption of 2050 (UNEP 2018).

The process of plastic synthesis causes depletion of hydrocarbon fuel storage at a high rate and production of many dangerous gases. Many other dangerous gases are produced during production of usable form of plastics from the raw plastics. Only polyurethane (P.U) consume 11 percent of total production of chlorine and 85 percent of total production of dangerous 'Phosgene' gas of the world during its formation. Always there is a chance of occupational hazards of workers, environmental pollution and death of a huge number of humans, animals and plants due to accidental leakage and spread of by-products. Plastics themselves are also toxic, and the key of their toxicity remains in the history of their production (Pattanayak 2007).

Plastics are the product of polymerization of several types of plastic monomers. Almost all such monomers that make up plastics are carcinogenic, mutagenic as well as disruptive of the normal functions of the endocrine system of our body. As the polymerization process cannot be made perfect at any time, so some toxic monomers are always present in the plastics. Beside these loose monomers, many other toxic materials are also present in the plastics. The colour materials (mainly Lead and Cadmium based pigments), plastic additives and other chemicals like foaming agents, plasticisers etc. which are used during preparation of various types of plastics and remain in it as a part, are very much toxic and most of them are carcinogenic. They all remain poorly bonded with the plastic polymers and tend to leach out and mix with the adhered materials when come in contact (Pattanayak 2007).

Many plastics can cause severe health hazards. As for example - Styrofoam products, which contain carcinogenic chemicals like styrene and benzene, are highly toxic if ingested. It can damage the nervous systems, lungs and reproductive organs. The toxins in Styrofoam containers can leach into food and drinks kept in it (UNEP 2018).

Toxicity of plastic additives

A wide range of additives are used in plastics, but the following additives are the most relevant to ecology and human health.

Bisphenol A

This monomer is used to prepare hard and clear plastics. It is used in polycarbonate made food and beverage containers and many other consumer products. It is very toxic. It acts as an endocrine disruptor and show activity like the female hormone estrogen. It leaches in variable amounts and mix with the contents. The leaching is dependent on the product and conditions, *i.e.* it is released more easily at higher temperatures and with changes in acidity.

Along with effects on endocrine chain of the body, evidences are found for association of it with chronic diseases, including cardiovascular diseases and Type 2 diabetes and even hormonal changes in adults (Lang *et al.* 2008, Galloway *et al.* 2010, Melzer *et al.* 2010).

Phthalates (diesters of 1, 2 – benzene dicarboxylic acid)

These are a group of industrial chemicals used as plasticizers, which make plastics more flexible or resilient. Phthalates are among them. Phthalates are extremely widespread and are found in items including toys, food packaging, hoses, raincoats, shower curtains and vinyl flooring. High-molecular weight phthalates [*e.g.* di (2-ethylhexyl) phthalate, DEHP] are primarily used as plasticizers, but the low-molecular weight phthalates (*e.g.* diethyl phthalate, DEP) are used as solvents in personal-care products.

Certain phthalates have been shown to function as endocrine disruptors, and to have anti-androgenic activity. They are not chemically bound to the plastic matrix and so they can easily leach out of products to contaminate the environment (Talness *et al.* 2009, Meeker *et al.* 2009). There are experimental evidences of negative impacts of phthalates on reproductive system of animals and these resemble human reproductive disorders, especially testicular dysgenesis syndrome, indicating a possible link between phthalate exposure and human disease. However, the dosages in animal study are likely to be much higher than exposure levels to humans. But studies are performed for limited periods only, which may not represent the actual detrimental effects of slow and continuous intake of these chemicals. Links have also been found between exposure to phthalates with obesity and allergies.

Brominated flame retardants

These are added with plastics mainly for safety reasons. As example, polybrominated diphenyl esters

(PBDEs) and tetra-bromo-bisphenol A (TBBPA) are added to a variety of consumer products, including textiles and thermoplastics used in electronics (*e.g.* televisions and computers). Throwing of such materials outside after use is dangerous, as it increases the chance of their toxicity much more. Studies indicate that PBDEs and TBBPA have hormone-disrupting effects, in particular on estrogen and thyroid hormones, and that exposure to PBDEs impairs development of the reproductive and nervous system (European Commission 2011).

Metals

All heavy metals are toxic to our health and many are used in plastics. As example, cadmium is used in plastics, especially in children's toys and in plastic crates and pellets. Waste plastic components of mobile phones have also been found to contain lead, cadmium, nickel and silver (Nnorom and Osibanjo 2009).

Indirect toxic effects of plastics

Effect on human health

Plastic bags can block waterways and can exacerbate natural disasters. By creating blockages in drains and providing breeding grounds for mosquitoes and pests, plastic bags can increase the transmission of vector-borne diseases like malaria (UNEP 2018). Thrown plastic packets and utensils may be the actual cause of spread of many other important vector-borne diseases like Dengue, Chikungunya etc.by providing breeding place of the vectors.

Various components are used in plastics and some are already detected inside our body. Components such as phthalates, bisphenol A (BPA), polybrominated diphenyl ethers (PBDE) and tetra-bromo-bisphenol A (TBBPA) are detected in humans. These chemicals are having the ability to alter our endocrine system. Phthalates can function as anti-androgens; BPA is having estrogen-like activity. PBDE and TBBPA can disrupt thyroid hormone homeostasis and PBDEs can also exhibit anti-androgen actions (Talsness *et al.* 2009).

Effect on animals

Animals can not differentiate cellulose and plastics, so generally engulf plastics as or with foods. It may be a cause of esophageal obstruction, but generally the plastics show most toxicity after reaching the stomach of the animals.

Among herbivorous animals, after the accumulation of plastic packets in the first part of stomach (rumen) reaches a certain limit, the affected animal suffers acute tympanites, which does not respond to any type of carminative or purgative drugs. It leads to starvation. The actual reason remains undiagnosed in almost all the cases and the ultimate fate of such animal is death after chronic suffering (Pattanayak 2007).

Fig. 1. Tolley Canal, Kolkata, India.

Animals get different types of toxins from and with plastics. Apart from direct eating of plastics, food stored in plastic packets, water in plastic containers, decomposed food items in thrown plastic packets etc. are the other main sources. Accumulation of many types of chemicals inside the body could affect the normal functioning of a cell, tissue or organ of animals. The absorption of lead and cadmium-based toxic coloring materials, additives and the toxic monomers of the plastic packet etc. can not only cause toxicity in animals, but they can reach human through consumption of milk and meat (Pattanayak 2007). There is evidence that the toxic chemicals added during the manufacture of plastic transfer to animal tissue, eventually entering the human food chain (UNEP 2018).

Effect on marine life

High concentration of plastic materials, particularly plastic carry-bags, has been found blocking the airways and stomach of hundreds of species living in the marine environment. Plastic bags are often ingested by turtles and dolphins mistakenly as food (UNEP 2018). Other major marine sources of the plastics are the abandoned or lost fishing nets and pots, plastic packing loops, six-pack carriers and plastic rope. Ghost fishing by such abandoned nets can trap and kill fish, which can reduce catches for fisheries (Derraik 2002, Gregory 2009).

UNEP (2006) claims that plastic waste causes the death of up to a million seabirds, 100,000 marine mammals and countless fish through various impacts. Laist (1997) reported that at least 267 different marine species are known to have suffered from impacts of plastic waste. This includes 86 per cent of all sea turtle species, 44 per cent of all seabird species and 43 per cent of all marine

Fig. 2. A pond of Brindabanchak, West Bengal, India.

mammal species. This is likely to be an underestimate as the list was prepared more than twenty years ago and there may be a large number of other species which were perhaps not studied and so their impacts were not included.

Plastics in the sea: collection and transport of other contaminants by plastic waste

Many of the hydrophobic contaminants are concentrated at sea surface and their levels are up to 500 times greater than in the underlying water column (Wurl and Obbard 2004). As most plastics float in sea water, they have the potential to adsorb these contaminants that are concentrated at the sea surface. The plastics can either transport the contaminants to other areas and, if washed up, the contaminants could be transferred to shoreline sediment (Teuten *et al.* 2007). Otherwise, the plastics could be eaten by wildlife and potentially transferred to their tissues and further up the food chain. Plastic could be subject to fouling and then sink to the bottom where it becomes part of the sediment or is eaten by benthic organisms that live on the sea bottom (European Commission 2011).

Impact on economy

Plastic wastes cause a huge economic damage. Plastic litter in the Asia-Pacific region alone costs its tourism, fishing and shipping industries $1.3 billion per year. In Europe, cleaning plastic wastes from coasts and beaches costs about •630 million per year. Studies suggest that the total economic damage to the world's marine ecosystem caused by plastic amounts to at least $13 billion every year (UNEP 2018).

Micro and Nano plastics and their effect on environment and human health

Micro plastic may be described a heterogeneous mixture of differently shaped materials referred to as fragments, fibers, spheroids, granules, pellets, flakes or beads, in the range of 0.1–5,000 µm. Micro plastics may be categorized as primary or secondary. Primary microplastics are plastics that were originally manufactured to be that size while secondary microplastics originate from fragmentation of larger plastic items like plastic debris (EFSA 2016).

Nano plastics can be defined as a plastic with any external dimension, internal structure or surface structure in the nano scale (0.001–0.1 µm). These can be produced during fragmentation of micro plastic debris and also can originate from engineered materials used, as in industrial processes (EFSA 2016).

It is estimated that at least 5 trillion pieces of plastics are floating in the oceans of the world. Out of this, over 90% are believed to be micro plastics (Eriksen *et al.* 2014).

Micro and nano plastics are likely to originate from other sources than the food itself. The main sources are processing aids, water, air or release from machinery, equipment and textiles. It is possible that the amount of micro plastics increases during processing. The effect of other processes like cooking and baking on the content of plastics is not known (EFSA 2016).

Microplastics can contain on an average 4% of additives and the plastics can also adsorb contaminants. Both additives and contaminants can be of organic or inorganic in nature. The main plastic additives and adsorbed contaminants comprise phthalates, bisphenol A, polybrominated diphenyl ethers, polycyclic aromatic hydrocarbons (PAHs) and polychlorinated biphenyls (PCBs) (EFSA 2016).

The characteristic high surface area to volume ratio of nano plastics may add to their potential hazardous effects, as other contaminants like organic pollutants, could be adsorbed and undergo bio-accumulation and bio-amplification (Da Costa *et al.* 2016). In a recent study, it was found that some of the nano-plastics caused damage to the DNA and cell membranes and produced oxidative stress in *Mytilus galloprovincialis*, a consumable mussel for human (Teles 2018).

Nano plastics can have a bigger capacity to concentrate toxic compounds either associated with its production or adsorbed from the environment. Indications suggest that nano plastics carry more toxins than micro plastics. Nano plastics can also carry more microorganisms (Mendoza *et al.* 2018).

The study on micro and nano plastics in the marine environment is attracting more attention due to their potential impact in sea organisms and humans. Human being generally does not eat digestive tract of the fishes, but fish meal prepared from whole fishes is used as feed ingredient in poultry production and pig rearing. So, micro plastics may end up in non-marine foods also (EFSA 2016).

Presence of micro and nano plastics in food prepared for human consumption and in air samples has been reported (Wright and Kelly 2017). Micro plastics on land and in the air are not studied as frequently as in aquatic environments. Evidence suggests that micro plastics can occur in terrestrial habitats and is present in the atmosphere. At least some micro plastics are able to pass through wastewater treatment plants (Nalbone 2015), a portion of the plastics are retained in the sewage sludge. If such contaminated sludge is applied to land (*e.g.* in agriculture), then micro plastics may spread in terrestrial environments (Rillig 2012). Micro plastics fibers were detected at an abundance of 29 to 280 particles/m^2/day on an urban rooftop as a consequence of atmospheric fallout (Gasperi *et al*. 2015). Plastic fibers (*i.e.* polyester) have been found in human lung tissue also (Pauly *et al.* 1998).

Micro and nano plastics can induce physical damage through particles itself and biological stress through them or with leaching additives (inorganic or organic) (Revel *et al.* 2018).

If inhaled or ingested, micro plastics may accumulate and cause localized particle toxicity by inducing or enhancing an immune response. Chemical toxicity might occur due to the localized leaching of component monomers, additives and adsorbed environmental pollutants. Chronic exposure might be of greater concern due to the accumulative effect of the micro or nano plastics. That may be dose dependent, but report of exhaustive study on that subject is not available (Wright and Kelly 2017).

As per some recent reports, nano-plastics are perhaps entering inside human body from different food chains, drinking water, other food items like honey, beer, salt etc. (Revel *et al.* 2018).

Nano plastics in drinking water

In a global survey of tap water taken from six regions on five continents, it was found that 83% of the samples contain plastic particles. Most these (99.7%) particles were fibers between 0.1 - 5 mm in length. The range was between 0 and 57 particles per liter. Availability of plastic particles in water samples were Beirut (94%), Europe (72%), Jakarta (76 %), Kampala (81%), U.S.A. (94%), Quito (75%). On an average, annual 'drinking' rate of plastic particles are over 4,000 for men and over 3,000 for women (Kosuth *et al.* 2017).

Dumping of pollutants by plastics

Teuten *et al.* (2007) found that pollutants adsorbed by the plastics at a much higher rate than that of natural sediments. The release of the pollutant occurs more rapidly from sediments than from plastics. It means that the plastics act like a sink for the pollutants by lessening their availability to the environment. It also means that plastics increase their lifetime in the environment by hindering their disposal by natural means, such as microbial degradation.

Thus, the use of plastic may be considered as synonymous with bringing pollution to the environment and accumulating poisons inside the living bodies (Pattanayak 2007).

Destruction of plastics

Most plastics do not biodegrade at all. Instead, they slowly break down into smaller fragments -microplastics. Studies suggest that plastic bags and containers made of expanded polystyrene foam (commonly referred to as "Styrofoam") can take up to thousands of years to decompose even after contaminating soil and water (UNEP 2018).

Burning

In many countries, plastic waste is often burned for destruction, heat or cooking. Disposing of plastic waste by burning it in open-air pits releases harmful gases like furan and dioxin (UNEP 2018). So, burning of plastics is equivalent to exposing people to emissions of toxic gases. It is not at all a way to get rid of the gathered or used plastics.

Recycling of plastics – Indian context

Only a few types of plastic can be recycled maximum another two or three times. But practically, a very small portion of used plastics are recycled. During recycling, many toxic gases are emitted, and the quality of the recycled plastics is always worse than the original one. The process is also not economically feasible in most of the time.

So, almost all plastics are manufactured to remain as a source of continuous threat to the civilization (Pattanayak 2007).

Condition in India

In India, nobody perhaps practically aware about the dangerous roles of plastics played. Almost everybody

forgot the old habit of carrying bag from home to the market. The thin plastic packets carrying individual items are generally gathered in another large sized plastic packet during marketing. The old system of use of disposable plates made from the leaves of Shal [*Shorea robusta* Roth. (Family: Dipterocarpaceae)] at parties, festivals, feasts and also for family use are replaced by disposable plastic plates. All such plastics are thrown just after single use in the ponds, lakes, canals, rivers or drains. Practically, almost all the canals of urban India are already converted to some open drains to carry all the biological, chemical and physical effluents gathered with different types of plastics to the rivers and then to sea. Underground water is considered as the only source of water to use in each and every purpose and the waste water is carrying the thrown plastics along with other effluents in this way (Fig. 1). In the rural areas, the ponds are converted to a dumping area of all of these (Fig. 2).

Recycling of plastic is not a very common practice in India. In the countries like India, it is hazardous for health of the people who are engaged in collection of thrown plastics from dirty dustbins and also work in the small, unlicensed factories of recycling.

International guideline for use of plastics

Given the broad range of possible actions to curb single-use plastics and their mixed impact, United Nations has drawn up a 10-step roadmap for all governments.

1.Target the most problematic single-use plastics by conducting a baseline assessment to identify the most problematic single-use plastics, as well as the current causes, extent and impacts of their mismanagement.

2.Consider the best actions to tackle the problem (*e.g.* through regulatory, economic, awareness, voluntary actions), given the country's socio-economic standing and considering their appropriateness in addressing the specific problems identified.

3.Assess the potential social, economic and environmental impacts (positive and negative) of the preferred short-listed instruments/actions. How will the poor be affected? What impact will the preferred course of action have on different sectors and industries?

4.Identify and engage key stakeholder groups – retailers, consumers, industry representatives, local government, manufacturers, civil society, environmental groups, tourism associations – to ensure broad buy-in. Evidence-based studies are also necessary to defeat opposition from the plastics industry.

5.Raise public awareness about the harm caused by single-used plastics. Clearly explain the decision and any punitive measures that will follow.

6.Promote alternatives. Before the ban or levy comes into force, assess the availability of alternatives. Ensure that the pre-conditions for their uptake in the market are in place. Provide economic incentives to encourage the uptake of eco-friendly and fit-for-purpose alternatives that do not cause more harm. Support can include tax rebates, research and development funds, technology incubation, public-private partnerships, and support to projects that recycle single-use items and turn waste into a resource that can be used again. Reduce or abolish taxes on the import of materials used to make alternatives.

7.Provide incentives to industry by introducing tax rebates or other conditions to support its transition. Governments will face resistance from the plastics industry, including importers and distributors of plastic packaging. Give them time to adapt.

8.Use revenues collected from taxes or levies on single-use plastics to maximize the public good. Support environmental projects or boost local recycling with the funds. Create jobs in the plastic recycling sector with seed funding.

9.Enforce the measure chosen effectively, by making sure that there is clear allocation of roles and responsibilities.

10.Monitor and adjust the chosen measure if necessary and update the public on progress. (UNEP 2018).

Yes, guideline is there, rules are also there.

But can we be able to change our vice of unnecessary use and throwing of plastics from today?

Shibabrata Pattanayak
Associate Editor,
Exploratory Animal and Medical Research

REFERENCES

Da Costa PJ, Santos PSM, Duarte ADC, Rocha-Santos TAP (2016) (Nano)plastics in the environment – sources, fate and effects. Sci Total Environ 566-567: 15-26.

Derraik GB (2002) The pollution of the marine environment by plastic debris: a review. Marine Polluti Bull 44: 842-852.

European Commission (2011) Plastic waste: ecological and human health impacts. Science for environment policy**.** http://ec.europa.eu/environment/integration/research/newsalert/indepth_reports.htm. Accessed on 21.08.2018.

EFSA Panel on Contaminants in the Food Chain (CONTAM) (2016) Presence of microplastics and nano-plastics in food, with particular focus on seafood. EFSA J 14(6): 4501.

Eriksen M, Lebreton LC, Carson HS, Thiel M, Moore CJ,

Borerro JC *et al.* (2014) Plastic pollution in the world's oceans: More than 5 trillion plastic pieces weighing over 250,000 tons afloat at sea. PloS One 9: e111913.

Galloway T, Cipelli R, Guralnik J,Ferrucci L, Bandinelli S, Corsi AM, Money C, McCormack P, Melzer D (2010) Daily Bisphenol A excretion and associations with sex hormone concentrations: results from the InCHIANTI adult population study. Environ Hlth Perspect 118: 1603-1608.

Gasperi J, Rachid D, Rocher V, Tassin B (2015) Microplastics in the continental area: an emerging challenge. Norman Bullet 4: 18-19.

Gregory MR (2009) Environmental implications of plastic debris in marine settings – entanglement, ingestion, smothering, hangers-on, hitch-hiking and alien invasions. Philosophic Transacti Royal Soc B 364: 2013-2025.

Kosuth M, Wattenberg EV, Mason SA, Tyree C, Morrison D (2017) Synthetic Polymer Contamination in Global Drinking Water. https://orbmedia.org/stories/Invisibles_final_report. Accessed on 18.09.2018.

Laist DW (1997) Impacts of marine debris: entanglement of marine life in marine debris including a comprehensive list of species with entanglement and ingestion records. In: Coe JM and Rogers DB (Eds.) Marine Debris - Sources, Impacts and Solutions. Springer-Verlag, New York. 99-139.

Lang IA, Galloway TS, Scarlett A,Henley WE, Depledge M, Wallace RB, Melzer D (2008) Association of urinary Bisphenol A concentration with medical disorders and laboratory abnormalities in adults. J Americ Medic Assoc 300(11): 1303-1310.

Meeker JD, Sathyanarayana, S, Swan SH (2009) Phthalates and other additives in plastics: human exposure and associated health outcomes. Philos Trans R Soc Lond B Biol Sci 364: 2097-2113.

Melzer D, Rice NE, Lewis C, Henley WE, Galloway TS (2010) Association of urinary Bisphenol A concentration with heart disease: evidence from NHANES 2003/06. PLoS One 5(1): e 8673.

Mendoza LMR, Karapanagioti H, Álvarez NR (2018) Micro (nano) plastics in the marine environment: Current knowledge and gaps. Current Opini Environmental Sci Health 1: 47-51.

Nalbone J (2015) Discharging microbeads to our waters: an examination of wastewater treatment plants in New York. Environmental Protection Bureau of the New York State Attorney General's Office. Available at: http://www.ag.ny.gov/pdfs/2015_Microbeads_Report_FINAL.pdf. Accessed on 26.7.2018.

Nnorom IC, Osibanjo O (2009) Toxicity characterization of waste mobile phone plastics. J Hazardous Materi 161: 183-188.

Pattanayak S (2007) Some aspects of plastic pollution. Livestock International 11(3): 21-23.

Pauly JL, Stegmeier SJ, Allaart HA, Cheney RT, Zhang PJ, Mayer AG, *et al.* (1998) Inhaled cellulosic and plastic fibers found in human lung tissue. Cancer Epidem Biomarkers Prevention 7: 419-428.

Revel M, Chatel A, Mouneyrac C (2018) Micro(nano)plastics: a threat to human health? Current Opinion Environmental Sci Hlth 1: 17-23.

Rillig MC (2012) Microplastic in terrestrial ecosystems and the soil? Environ Sci Technol 46: 6453-6454.

Teles M (2018) First time observation of genetic/physiological damage caused by nanoplastics in mussels. Autonomous University of Barcelona, July 26, 2018, availability of https://m.phys.org. Accessed on 01.11.2018.

Talsness CE, Andrade AJM, Kuriyama SN, Taylor JA, Vom Saal FS (2009) Components of plastic: experimental studies in animals and relevance for human health. Philos Trans R Soc Lond B Biol Sci 364(1526): 2079-2096.

Teuten EL, Rowland SJ, Galloway TS, Thompson RC (2007) Potential for plastics to transport hydrophobic contaminants. Environ Sci Technol 41: 7759-7764.

United Nations Environment Programme (UNEP) (2006) Ecosystems and biodiversity in deep waters and high seas. UNEP regional seas reports and studies No. 178. UNEP/ IUCN, Switzerland. 50-54.

United Nations Environment Programme (UNEP) (2018) Single-use plastics: a roadmap for sustainability. Available at : www.unenvironment.org/resources/report/single-use-plastics-roadmap-sustainability. Accessed on 18.08.2018.

Wurl O, Obbard JP (2004) A review of pollutants in the sea-surface microlayer (SML): a unique habitat for marine microorganisms. Mar Pollut Bull 48: 1016-1030.

Wright SL, Kelly FJ (2017) Plastic and Human Health: A Micro Issue? Environ Sci Technol 2051(12): 6634 -6647.

***Cite this article as:** Pattanayak S (2018) Thrown plastics – cause of an incoming global disaster. Explor Anim Med Res 8(2):133-139.

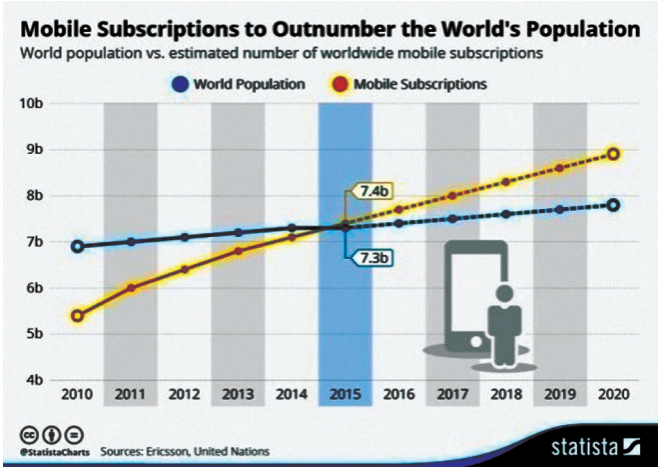
Explor Anim Med Res,
Vol. 8, Issue - 1, 2018, p. 5-10

ISSN 2277- 470X (Print), ISSN 2319-247X (Online)
Website: www.animalmedicalresearch.org

Editorial

MOBILE PHONE AND TOWER RADIATION: A CHALLENGE TO ALL LIVING ENTITIES

Use of mobile phone is increasing at a great speed every day. It is now becoming like a body part to many individuals, especially of younger generations. Cellular phone technology has revolutionized the global telecommunication scenario with exponential increase in cell phones and mobile towers. As it is also a very good scope for business, majority of mobile phone towers are mounted near the residential area on the residential and office buildings to provide good coverage to the users. These towers continuously transmitting radiation on the exposing residents in proximity to 10^4 to 10^7 times stronger signal (Ghildiyal *et al.* 2014). In addition to the continuous radiation from mobile towers and mobile phones or wireless phones, many other such radiations - like radiations from computers, laptops, TV towers, FM and AM broadcasting towers, microwave ovens etc. are encountered everyday by us. We are exposed to all these radiations, which are additive in nature (Ghildiyal *et al.* 2014).



Source: Ericsson, United Nations (Statista Chart).

Population growth and increase in mobile phone use

As per the prediction of United Nations department of economic and social affairs (2017), world's present population is about 7.2 billion. World Economic Forum mentioned that the mobile industry is now in explosive growth worldwide with an ever-growing demand for data traffic. In the year 2017, the mobile phone users are in 4.77 billion and expected to reach about 5 billion in 2019. As per the available data, the number of mobile subscribers has already exceeded the number of world population (Statista 2013-2019)! So, many persons are accustomed with use of more than one mobile phone connection.

In India, the telephone subscribers using wireless form of communication in urban area is 63.27% and in rural area 33.20% of population as per the report of Telephone Regulatory Authority of India (TRAI) (Saravanamuttu *et al.* 2016).

Living in the sea of electromagnetic radiations

Flora and fauna including human beings are flooded with massive amounts of powerful wireless Electromagnetic Radiations (EMR). We are now exposed to hundred million times more EMR than our grandparents were. Cell Towers emit high-frequency microwaves (about 1900 MHz) and spread in biosphere. Both base stations (BS) and the mobile phones (MP) regularly waste 70% of the energy. Health hazards by EMR may be thermal and non-thermal. The thermal effect is like cooking in microwave oven, but a lot of damages done by the non thermal effects (Kour *et al.* 2016).

Radiation Frequencies

Mobile Phone Tower's antennas transmit in the frequency range of 869 - 894 MHz (CDMA), 935 - 960 MHz (GSM 900) and 1810 – 1880 MHz (GSM 1800) in Second Generation (2G), 2110 – 2170 MHz in 3G, 2300 - 2400 MHz in 4G, 2400 - 2500 MHz in Wi-Fi, Blue Tooth and 3400 - 3600 MHz in 5G services. Living entities staying within 10 meters from Mobile Towers receiving 10 thousand to 1 lakh times stronger signal (radiation) than the requirement (Akbal *et al.* 2012). People living within 50 meters of towers having more health problems than those living outside (Pachuau and Pachuau 2014). So, closer to people near the towers, greater the danger. Millions of people residing within high radiation zones in our country and our environment is highly exposed to electromagnetic waves by many sources, including mobile devices (Akbal *et al.* 2012).

Time limit for mobile phone use

The Specific Absorption Rate (SAR) value is the radiation absorbed by living organisms including people, measured in units of watts per kg (w/kg) of tissue. The limit is 1.6W/Kg for 6 minutes per day usage and the margin of safety 3 - 4 times. So, more than 18 - 24 minutes per day use is not safe. Millions of people are not aware of it and using mobile phones throughout almost the entire non-sleeping period daily without realizing its associated health problems (Kumar 2010).

Reports from India

A study on the quantification of electromagnetic field (EMF) radiation from mobile towers and their health impacts on human beings have been carried out in Kota city of Rajasthan. It has been noticed that EMF radiation from almost 50% of the mobile towers installed in Kota city is beyond the permissible limits prescribed by the DoT, Govt. of India (Vijay and Choudhary 2017).

Effects on human

The Food and Drug Administration (FDA), Indian Council of Medical Research (ICMR) and many other research workers reported that radiation from both mobile phone and towers causes adverse health effects. After absorption of electromagnetic radiation, the body is heated internally and causing damage to various organs. High exposure can also instigate Alzheimer's disease, Morgellon's disease, Tinnitus, bone weakening; sleep disorders, neurodegenerative diseases and even high cancer risk (Ghildiyal *et al.* 2014).

Several studies reported irregular heart beat and pulse rate when mobile phones are placed on chest (closer to heart) and on ear (closer to brain) for a specific time (Mitra *et al.* 2014). Significant effects were observed on heart rate and blood pressure due to exposure of mobile phone radiation (Aghav *et al.* 2018). It can interfere normal works of implanted Cardiac Pacemakers, implantable Cardiovascular Defibrillators (ICDs) and Impulse Generators (Ghoshdostidar *et al.* 2011). Epidemiological studies among MP radiation exposed people revealed sleeping disturbances, discomfort, headache, irritability, appetite loss, nausea, muscle spasms, depression, nervousness, agitation, concentration difficulties, visual disorders, changing blood pressure, cardio-vascular problems etc. (Kumar 2010, Jain and Bansal 2017). Occupational health hazards found much more in Telecom workers working closely with equipments for testing, maintenance, installation, etc. with much greater exposure (Soju *et al.* 2015).

How it works?

As human body consists of 70% liquid, it absorbs electromagnetic radiation, when it is exposed. It is similar to that of cooking in the microwave oven, where the water in the food content is heated first. Microwave absorption effect is much more significant by the body parts, which contain more fluid (water, blood etc.), like the brain which consists of about 90% water. Effect is more noticeable where the movement of the fluid of the organs is less. So, the fluids of eyes, brain, heart, abdomen, joints etc. are affected much more. As human height is much greater than the wavelength of the cell tower transmitting frequencies, so multiple resonances in the body happens which creates localized heating inside the body. This results in boils, drying up of the fluids around eyes, brain, heart, abdomen, joints etc. (Sharma and Lamba 2017).

Electromagnetic radiations are having various other effects also, including causing deterioration in large molecules in cell, imbalance in ionic equilibrium, damaging of cellular components such as proteins, lipids and DNA (Elfide 2017).

Effect on blood-brain barrier leading to cancer

The blood-brain barrier selectively allows nutrients to pass from the blood to the brain, but keeps toxic substances out. As per available reports, a single two-hour continuous exposure to a cell phone just once during lifetime may permanently damage the blood-brain barrier. Due to this, besides increase in brain tumour and acoustic neuroma, there is also increased risk of several other types of cancers following prolonged exposure to mobile phone/ tower radiation continuously. Among these, salivary gland tumours, tumours at the eyes and facial nerve, lymphoma, skin, blood, testicular and breast cancer etc are important (Sharma and Lamba 2017).

Causing hearing loss and ear tumour

Temperature of ear lobes increases by approximately 10°C when mobile phones are used for 20 minutes continuously and prolonged use of it can cause auditory disturbance in terms of hearing loss (Sharma *et al.* 2016).

The radiation emitted by mobile phones may damage the delicate parts of the inner ear. Persons using cell phones 2-3 hours every day are inviting the risk of partial deafness over 3 to 5 years. The problem generally starts with a pain in the ear that gradually develops into tinnitus or a ringing sensation. That may finally lead to hearing loss and / or ear tumour (Sharma and Lamba 2017).

Causing problems of eyes

Frequent use of mobile phones can also damage the visual system in different ways and may also cause uveal melanoma *i.e.* tumour of the eye. Increase in temperature due to the effect of electro-magnetic radiation close to

the eye lens may result in lens opacities and thus increase the risk of developing cataracts. Prolonged exposure may lead to both macroscopic and microscopic damage to the eye lens and this damage seems to accumulate over time and may not heal afterwards (Sharma and Lamba 2017).

Causing irreversible infertility

In one report**,** the American Society for Reproductive Medicine stated that decrease in semen quality by affecting the sperm count and motility, viability and normal morphology of the sperm is related to the duration of cell phone use.

In sperm count, it appears that 30% sperm decrease in number among intensive mobile phone users. The physical damage of sperms is another effect. Cell phone radiation can cause breaks in DNA of sperm cells and cause cancer through that mutation. Damage to sperm DNA is dangerous as it can pass such genetic changes to subsequent generations (Sharma and Lamba 2017).

Effects on children and pregnant women

National Radiological Protection Board (NRPB) mentioned that mobile phone radiation affects children more than adults due to smaller and thinner skull, soft skin, smaller brain size, more elastic ears, lower blood cell volume, greater conductivity of nerve cells, higher cell division rate, more susceptibility to genetic damage, more radiation penetration and for more in longer life time exposure. Children may suffer from disruption of memory, decline of attention, diminishing learning and cognitive abilities, increased irritability in the shorter period exposures due to use of mobile phones. In longer period exposures, the hazards includes depressive syndrome, degeneration of the nervous structures of the brain etc. (Kumar 2010).

Electromagnetic radiations can damage the placental barrier of pregnant woman, which protect fetus in the mother's womb (Sharma and Lamba 2017). It may cause early spontaneous abortions due to effect on fetal development (Mahmoudabadi *et al.* 2015). More use of mobile phones during pregnancy in women may give birth of child with behavioral problems (Sharma and Lamba 2017).

Effects on animals

Animals staying near mobile towers are prone to various dangers including still births, spontaneous abortions, birth deformities, behavioural problems and declining overall health status (Vijoy *et al.* 2015). It may be due to changes in intracellular ionic concentration, cellular proliferation, genotoxic effects, interferences with immune system, effects on stress hormones, reproductive, nervous and circulatory system (Rafiqi *et al.* 2016). Numerous studies have been pointed mobile phone towers as a potential cause of health hazards and decline of animal populations including free-tailed bats (*Tadarida teniotis*) in bat colony (Rafiqi *et al.* 2016).

Effects on birds

Millions of migratory birds die each year from collisions with telecom masts. Ministry of Environment and Forests has ordered further study on the impact of EMR from MP towers on wildlife birds (The Hindu 2012). Birds when exposed to any electromagnetic field, they lose the power of orientation, natural navigation and may fly at any direction. Pigeons, sparrows, swan and others may be affected due to interference from the "unseen enemy", the mobile phone masts (Vijoy *et al.* 2015). It is rare to notice that birds like sparrow, pigeon etc. staying or flying near the MP towers (Vijoy *et al.* 2015, Kaur 2016). The radiation absorption is more in birds than human or animal due to more body surface area to body weight ratio. Since fluid content is small due to less weight, it gets heated up very fast and the magnetic field affects their navigational skills (Soju *et al.* 2015, Rafiqi *et al.* 2016). Vijoy *et al.* (2015) reported that electromagnetic pollution may be possible cause for decline of amphibian populations with some deformation.

Effects on bees and insects

Bees are important to pollinate about 90 commercial agricultural crops worldwide. Scientists warn that the steady decline in bees and other pollinators could trigger more crisis in future than global warming. Electromagnetic radiation affecting the life cycle of honey-bees may cause pollination disturbance. It affects navigation, reproduction, honey production ability and disruption of biological clocks (El Halabi *et al.* 2014). Several workers reported the sharp declining honey bee populations *i,e* Colony Collapse Disorder (CCD) with potential health hazards due to prolong mobile phone tower radiation (Taye *et al.* 2017).

Insects are the key species of ecosystem and found very sensitive to electromagnetic radiations. Studies revealed sharp decrease in population of ants, beetles and other insects close to MP towers. Cammaerts and Johansson (2014) reported that 900 MHz radiation have some impact on nervous system of exposed ants, effects on their physiology, social behavior, orientation and navigation.

Effects on plants

Electromagnetic radiation emitted from MP towers

may affect plants, vegetables, crops etc. (Vijoy *et al.* 2015). A study found that the production of betel nuts and coconuts have been decreased after the installation of mobile tower (Debnath and Bora 2015).

Parihar (2014) reported that electromagnetic radiations from mobile phones and towers can interfere the morphological and biochemical process, growth and nodule formation in the plants. It also affects vegetables and crops in its vicinity, inhibit germination and growth of roots etc. Top of the trees tend to dry up when directly face the MP tower antennas (Sathishkumar *et al.* 2017). Trees located around 50 meters of Mobile towers look sad, feeble, dried tops, slow growth with illness (Debnath and Bora 2015).

Role of WHO

World Health Organization (WHO)'s International Agency for Research on Cancer (IARC) in the year 2011, has classified electromagnetic radiation from wi-fi, mobile phone and towers as category 2(B), *i,e* 'possibly carcinogenic to human'(Hardell 2017). Dariusz Leszczynski, a scientist of IARC expert committee, mentioned that long term average of 30 minutes daily radiation exposure, increases the risk of brain tumour and cancer. WHO again launched a draft in the year 2014, where dismissed the adverse health hazards by radiation, mentioning a proposal for re-evaluation of exposure effects to the people and environment (Hardell 2017). As no conclusive evidence of carcinogenesis was finalized by mobile phone and towers exposure, a long-term exhaustive research study is perhaps required to understand actual effects worldwide.

Guideline to install mobile tower

Different countries like USA, Canada, New Zealand, Belgium, Italy etc. have issued mobile phone and towers exposure standard. In India, MP towers are permitted to emit at 0.45 watts per square meter at 900 MHz, less than international standard. Recently, India Govt. has decided to limit one-tenth of the existing level of base station emissions. Ministry of Environment and Forests engaged an expert group to study the possible impacts of communication towers on wildlife including birds and bees. In their report, many recommendations are forwarded by the members to reduce EM radiation (http://www.moef.nic.in). Many international guidelines published and adopted by many countries, but guidelines of ICNIRP (International Commission for Protection against Non-Ionizing Radiation) are accepted most worldwide (Non-ionizing radiation protection standards and policies 2010).

Rules and regulations

For a long time the Government is forming new rules and regulations to protect health of its citizens. The ICNIRP is an international commission, whose activities include determining exposure limits for EM fields used by devices such as mobile phone. In India, Department of Telecommunication has ordered the mobile phone companies to follow all the guidelines of ICNIRP and as per the Environment (Protection) Act, 1986 the rules includes the following basic points:

1. Cell phone towers should be installed far from the public place, residential, agricultural, school, hospital areas etc.
2. More number of mobile phone towers along with less transmission power facilities are to be provided.
3. In multiple transmission sites at specific locality should sharing of a common tower infrastructure, to be coordinated through any nodal agency.
4. Safe distance between towers and residences to be maintained with regular monitoring of radiation levels.
5. Radiation measurements must be done by independent and trustworthy third party, rather than self-certification by the operators.
6. Base station antenna sites should be prohibited to access by general people. Public should be discourage longer stay in the zone of base station, even for the maintenance personnel.
7. Sign boards or warning signs to be provided at base station / tower sites, must be clearly visible and identifiable. A warning sign should be placed at the entrance of such zones.
8. The service provider will be liable for penal action, if the guidelines are violated.

Cumulative effect of electromagnetic radiation: what next?

Actually wireless technologies are not environmental-friendly, even it utilize about 10 times more power than wired technologies (Baliga *et al.* 2011). Mobile phone is now one of the booming industry and its usage increasing day by day among people with addiction and without considering darker side of this technology. More numbers of Mobile phone towers and amplifiers are added day by day worldwide considering havoc demand.

We are exposing continuously to uninterrupted radiation comes from different appliances like mobile phones and towers, microwave ovens, Laptops, FM radio towers etc. These all are working together. Therefore, policy makers should be active enough to form strict radiation norms. Researchers, industrial people,

entrepreneurs have to come out immediately with effective solutions, which may be costly but never greater than the risk that is faced by human, animals, birds and environment (Ghosh *et al.* 2017). Proposal already initiated regarding placing of heterogeneous networks of cells at indoor level with faster connectivity, lower radiation and low power utilization as some effective alternative to present mobile phone tower system (Saravanamuttu *et al.* 2016).

More consciousness about health, reduction of time of use of cell phones within permissible limit, use of mobile phone as some utility item and not any item for entertainment, prohibition of use of mobile phones by children and pregnant women, arrangement of provisions to reduce radiation and constant research to reduce the harmful effects of that technology may lead us to a better condition in future.

Rajdeep Mitra
Assistant Professor (ECE),
Ideal Institute of Engineering, Kalyani,
Nadia, West Bengal, India.

Shibabrata Pattanayak
Associate Editor,
Exploratory Animal and Medical Research

REFERENCES

Aghav SD, Patil DS, Yande JV (2018) Environmental pollution due to mobile phone radiation, high voltage powerline radiation and investigating its effects on heart rate and blood pressure. Int Res J Sci Engg, Special Issue A3: 134-138.

Akbal A, Kiran Y, Sahin A, Turgut BD, Balik HH (2012) Effect of electromagnetic waves emitted by mobile phones on germination, root growth and root tip cell miotic division of *Lens culinaris* Medik. Pol J Environ Stud 21(1): 23-29.

Baliga J, Ayre R, Tucker RS (2011) Energy consumption in wired and wireless access networks. IEEE Communications Magazine (https://people.eng.unimelb.edu.au/rtucker/publications/files/energy-wired-wireless.pdf) 70-77. Cited in http://www.electricalpollution.com/WirelessKillsTrees.html. Accessed on 12.04.2018.

Cammaerts MC, Johansson O (2014) Ants can be used as bio-indicators to reveal biological effects of electromagnetic waves from some wireless apparatus. Electromag Biol Med 33(4): 282-288.

Debnath D, Bora M (2015) A survey on the impact of cell phone tower radiations on some nut and banana plants. Internat J Adv Res Sci Engg 4(2): 166-171.

Elfide GK, Kýymet KY, Arife AK, Iþýnsu A, Gamze A (2017) Effects of electromagnetic fields exposure on the antioxidant defense system. J Microscopy Ultrastruct 5(4): 167-176.

El halabi N, Achkar R, Haidar GA (2014) The effect of cell phone antennas' radiations on the life cycle of Honeybees. IEEE Mediterranean Electrotechnical Conference (MELECON) 408-414.

Ghildiyal V, Dabas S, Bhardawaj A (2014) A critical review on mobile radiations effects: problems and remediation. Internat J Info Computation Technol 4(8): 853-858.

Ghoshdostidar S, Guha SK, Neogi S, Kumar G (2011) Cell phone tower radiation hazards. Report of technical advisory committee, IIT, Kharagpur and Bombay, submitted to the Ministry of Environment, Govt. of West Bengal .

Ghosh PM, Paul LC, Zainul-Abadin AFM (2017) A review of the potential health hazards of radio frequency radiation from cellular base station, British J Applied Sci Tech 20(4): 1-8.

http://www.moef.nic.in/downloads/public-information/final_mobile_towers_report.pdf. Report on possible impacts of communication towers on wildlife including birds and bees. Accessed on 11.04.2018.

ICNIRP (2010) Guidelines for limiting exposure to time varying electric and magnetic fields (1hz – 100 khz), Health Physics 99(6) : 818-836.

Jain A, Bansal S (2017) Electromagnetic radiations: hazardous or not? Internat Res J 6(4): 51-54.

Kaur J (2016) Effects of electromagnetic radiations from cell phone towers on bird community. Thesis for Master of Science in Zoology, submitted to the Punjab Agricultural University, Ludhiana.

Kaur S, Kaur J, Sandhu M (2016) Effects of mobile radiations and its prevention. Internat J Computer Sci Mobile Computing 5(2): 298-304.

Kumar G (2010) Report on cell tower radiation, IIT Bombay, Electrical engineering department, submitted to Secretary, DOT, Delhi, on December, 2010.

Hardell L (2017) World Health Organization, radiofrequency radiation and health - a hard nut to crack. Internat J Oncology 51(2): 405-413.

Mahmoudabadi FS, Ziaei S, Firoozabadi M, Kazemnejad A (2015) Use of mobile phone during pregnancy and the risk of spontaneous abortion, J Environ Health Sci Engg 13: 34.

Mitra R, Mazumder M, Pal K, Jana S (2014) A study on effect of mobile phone radiation on human health. Explor Anim Med Res 4(2): 246-252.

Non-Ionizing Radiation Protection Standards and Policies (2010) Instituto edumed para educaçãoem medicina e saúde. www.wireless-health.org.br/downloads/LASR2010-Protection Standards-Policies. Accessed on 11.04.2018.

Pachuau L, Pachuau Z (2014) Study of cell tower radiation and its health hazards on human body. IOSR J Applied Physics 6(1): 01- 06.

Parihar L (2014) Effect of mobile phone radiation on nodule formation in the leguminous plants. Current World Environ 9(1): 145-155.

Rafiqi SI, Kumar S, Chaudhary R, Farooq UB, Kirthika P (2016) Mobile phone radiations and its impact on birds, animals and human beings. Trends Vet Anim Sci 3: 24-27.

The Hindu (17.02.2012) Ministry orders study into cell tower impact on birds. (www.thehindubusinessline.com/...into-cell-tower-impact...birds/article20399778.ece). Accessed on 10.04.2018

Saravanamuttu S, Jayakumar A, Amiratha V, Sudarsanam D (2016) Survey of people living at the vicinity of cellular base transmitting stations in an urban and a rural locality, Int J Current Res 8(4): 29030-29038.

Sathishkumar D, Balaji L, Marshall B (2017) A survey on hazards of cell phone tower radiations. Internat J Appli Info Comm Engg 3(1): 41-45.

Sharma AB, Lamba OS (2017) A review: source and effect of mobile communication radiation on human health. Adv Wireless Mobile Comm 10(3): 423-435.

Sharma N, Uma G, Deepak V, Sandeep R (2016) Audiological disturbances in chronic mobile phone users, European J Pharma Med Res 3(10): 239-242.

Soju A, Trivedi P, Purohit D (2015) Health hazards of mobile phones and towers. WORKOSH - An official newsletter of ENVIS-NIOH, National Institute of Occupational Health, Meghaninagar, Ahmedabad – 380016. 10(3): 01-08.

Statista (2013-2019) Number of mobile phone users worldwide. https://www.statista.com › Technology & Telecommunications › Telecommunications. Accessed on 08.04. 2018.

Taye RR, Deka MK, Rahman A, Bathari M (2017) Effect of electromagnetic radiation of cell phone tower on foraging behaviour of Asiatic honey bee, Apiscerana F. (Hymenoptera: Apidae), J Entom Zool Studies 5(3): 1527-1529.

United Nations, Department of Economic and Social Affairs (2017) A report on world population published in 21 June 2017, New York. https://www.un.org/development/.../population/world-population-prospects-2017.html, Accessed on 08.04.2018.

Vijay S, Hegde A, Sushma (2015) Study on electromagnetic radiation from cell phone towers and their effects on animals, plants and environment, Intern J Innovat Res Computer Comm Engg 3(7): 370 - 374.

Vijay S, Choudhary MP (2017) Study on electromagnetic field radiation emission from mobile towers in Kota city, Internat J Innovat Res Sci Engg Tech 6(11): 21402 - 21409.

***Cite this article as:** Mitra R, Pattanayak S (2018) Mobile phone and tower radiation: a challenge to all living entities. Explor Anim Med Res 8(1): 5-10.

Explor Anim Med Res,
Vol.7, Issue - 2, 2017, p. 125-131

ISSN 2277- 470X (Print), ISSN 2319-247X (Online)
Website: www.animalmedicalresearch.org

Editorial

PROCESSED FOODS – ARE THEY SAFE?

Processed foods contain food particles at different forms added with different additives. Apart from the effects of food items with high calories which may have very strong relation with obesity, diabetes, high blood lipids, high blood pressure etc., processed foods may have many other effects. The present article deals with the food additives of the processed foods.

Food additives

Food additive means any substance not normally consumed as a food by itself and not normally used as a typical ingredient of the food, whether or not it has nutritive value, the intentional addition of which to food for a technological (including organoleptic) purpose in the manufacture, processing, preparation, treatment, packing, packaging, transport or holding of such food results, or may reasonably expected to result, (directly or indirectly) in it or its by-products becoming a component of or otherwise affecting the characteristics of such foods (Codex 2013).

As per WHO (2017), substances that are added to food to maintain or improve the safety, freshness, taste, texture, or appearance of food are known as food additives.

So, all the items added with the nature given food or food particles may be regarded as food additives.

Recommendation of FDA

In the globe, United States Food and Drug Administration (FDA) is perhaps the strongest influential body for giving permission to any food additive to be mixed with any food item. As per the literature of FDA, "when evaluating the safety of a substance and whether it should be approved, FDA considers: 1) the composition and properties of the substance, 2) the amount that would typically be consumed, 3) immediate and long-term health effects, and 4) various safety factors''.

As per the statements published by FDA and International Food Information Council (IFIC) Foundation, different food additives along with color materials used with food with particular purpose are shown in Table 1.

FDA also recommended the permitted food additives with the comment as "food ingredients have been used for many years to preserve, flavor, blend, thicken and color foods, and have played an important role in reducing serious nutritional deficiencies among consumers. These ingredients also help ensure the availability of flavorful, nutritious, safe, convenient, colorful and affordable foods that meet consumer expectations year-round.... all additives are subject to ongoing safety review as scientific understanding and methods of testing continue to improve. Consumers should feel safe about the foods they eat".

The certificate of FDA is considered a base of idea for addition of food additives in many other countries. But many questions can be raised against such practice.

The other look

Expression of toxicity and adverse reactions

It was found many times in the history of drug development that many strongly effective molecules were identified as toxic to the people following use among patients for years. Many important drugs (medicines) can react with other drugs inside the body of the treated persons and may cause many serious health problems. When common people take such drugs with or without the advice of the physicians, ultimately suffer for their toxicity or adverse drug reactions. In many cases, such after effects are felt by the consumers after a long time. So, without having any scope to know the actual reasons, they have no other way than to consider these detrimental health effects as 'ill fate'.

The old episode of use of Thalidomide in pregnant mothers on 1957 and the recent episode of use of Nimesulide among children up to 2010 can be remembered as some examples.

How the food additives work inside the body system? It follows almost the same pathway of detoxification and excretion like those of drugs after absorption from the intestine. The difference is that people do not take medicines regularly, but many of them regularly take a huge number of such additives!

Excretion of a certain percentage of almost all introduced drugs (orally fed or injected) from the living body are not identified. Perhaps a portion of them remain inside the body at different tissue level. Same may happen for the introduced chemical additives of processed food and food products.

Relating to it, many works for determination of toxic effects of food additives by standard laboratory methods were performed and reported (Al-Shammari *et al.* 2014, Thomas and Adegoke 2015, Sales *et al.* 2017).

Fig. 1.The 'Edible oil' carried to the fast food stalls and road side restaurants in Kolkata, India.

Long term toxicity study

Though it is a common claim of the concerned authorities of performing study for short term and long term effects of the food additives before considering them safe, the actual long term effect study on human health is practically impossible by the present analytical systems and techniques. A modern day man does not consume only one type of food or beverage daily. In a lifespan average of 70 years, he or she took food and drinks of enormous types. So, numerous types of food additives enter in their body on regular basis. How the effect of those food additives can be evaluated by any animal or *in vitro* model?

In the FDA statements, this limitation is also touched. "Because of inherent limitations of science, FDA can never be absolutely certain of the absence of any risk from the use of any substance. Therefore, FDA must determine - based on the best science available, if there is a reasonable certainty of no harm to consumers when an additive is used as proposed".

Re-evaluation of FDA recommendations by the scientific communities

The recommendations of FDA are not outside the re-evaluation of the scientists. Some limitations of the FDA recommendations are shown in Table 2, where the author listed fifty toxic food ingredients and artificial additives which should be avoided for their potential toxicity. As per the author, "while FDA generally recognizes most additives on this list as 'safe,' there are growing concerns about the safety of many common food additives, if consumed in large quantities" (MPH Programs List).

The 'Natural' additives

Many additives are mixed with food as 'natural' without disclosing the name and state of use of such additives perhaps just to attract consumers, but their claim may not be true in most of the cases. As for example - some flavoring food additives are claimed as 'natural', but as per the definition, the 'natural' flavoring agents include nut, fruit and spice blends, as well as those derived from vegetables and wine (WHO 2017). So it can be said that in many cases, nature identical synthetic chemicals or some extracted derivative of a natural agent is added with the food in the name of 'natural'.

The Indian condition

In India, the control over mixing of additives in different food items during preparation of processed foods is not above the level of questioning. Practically, anybody can mix any types and numbers of additives and adulterants during preparation of food or food item at local level. Most of the consumers search only the cheapest food, food items and food products without considering their quality, food value or danger of the mixed adulterants and additives. In many cases, the prepared processed food is sold at a far lower cost than the total cost of the items used to prepare it!

The quality of famous dairy item of vegetarians of India – *Paneer* (cheese) – sold elsewhere in Indian market are never checked. It is sold at Rs. 100 per kilogram in wholesale market which is lower than the cost of even three liters of milk! The famous non vegetarian item – *Biriyani*, sold in the road side restaurants of India at a rate of Rs. 50 per packet, lower than the cost of approximately 100 grams of mutton/chevon used in it! As per some report - cheap toxic colorants used during color festival *Holi* are detected by some Indian researchers in some famous sweet items in India (Pattanayak 2014). Many deep fried items are famous everywhere in India. Checking of the quality, source, sale and transportation of that black colored oil (in the name of Palm oil) is perhaps beyond the control of any agency (Fig. 1.).

Questions for safe certificate from the Indian point of view

From the point of view of an Indian, the contemporary toxicity study of food additives, listing of the safe food additives and overall consideration of prepared processed foods as 'safe' have the following limitations.

Table 1. Use of different chemicals as food additives.

Ingredient	Action	Example of use	Names found on product level
Preservatives	Prevent food spoilage from bacteria, molds, fungi, or yeast (antimicrobials); slow or prevent changes in color, flavor, or texture and delay rancidity (antioxidants); maintain freshness	Fruit sauces and jellies, beverages, baked goods, cured meats, oils and margarines, cereals, dressings, snack foods, fruits and vegetables	Ascorbic acid, citric acid, sodium benzoate, calcium propionate, sodium erythorbate, sodium nitrite, calcium sorbate, potassium sorbate, BHA, BHT, EDTA, tocopherols (Vitamin E)
Sweeteners	Add sweetness with or without the extra calories	Beverages, baked goods, confections, table-top sugar, substitutes, many processed foods	Sucrose (sugar), glucose, fructose, sorbitol, mannitol, corn syrup, high fructose corn syrup, saccharin, aspartame, sucralose, acesulfame potassium (acesulfame-K), neotame
Color Additives	Offset color loss due to exposure to light, air, temperature extremes, moisture and storage conditions; correct natural variations in color; enhance colors that occur naturally; provide color to colorless and "fun" foods.	Many processed foods, (candies, snack foods, margarine, cheese, soft drinks, jams/jellies, gelatins, pudding and pie fillings)	FD&C Blue Nos. 1 and 2, FD&C Green No. 3, FD&C Red Nos. 3 and 40, FD & C Yellow No. 5 (tartrazine) and No. 6, Orange B, Citrus Red No. 2, annatto extract, beta-carotene, grape skin extract, cochineal extract or carmine, paprika oleoresin, caramel color, fruit and vegetable juices, saffron (Note: Exempt color additives are not required to be declared by name on labels but may be declared simply as colorings or color added)
Flavors and Spices	Add specific flavors	Pudding and pie fillings, gelatin dessert mixes, cake mixes, salad dressings, candies, soft drinks, ice cream, BBQ sauce	Natural flavoring, artificial flavor, and spices
Flavor Enhancers	Enhance flavors already present in foods (without providing their own separate flavor)	Many processed foods	Monosodium glutamate (MSG), hydrolyzed soy protein, autolyzed yeast extract, disodium guanylate or inosinate
Fat Replacers (components used to replace fats)	Provide expected texture and a creamy "mouth-feel" in reduced-fat foods	Baked goods, dressings, frozen desserts, confections, cake and dessert mixes, dairy products	Olestra, cellulose gel, carrageenan, polydextrose, modified food starch, micro particulated egg white protein, guar gum, xanthan gum, whey protein concentrate
Nutrients	Replace vitamins and minerals lost in processing (enrichment), add nutrients that may be lacking in the diet (fortification)	Flour, breads, cereals, rice, macaroni, margarine, salt, milk, fruit beverages, energy bars, instant breakfast drinks	Thiamine hydrochloride, riboflavin (Vitamin B2), niacin, niacinamide, folate or folic acid, beta carotene, potassium iodide, iron or ferrous sulfate, alpha tocopherols, ascorbic acid, Vitamin D, amino acids (L-tryptophan, L-lysine, L-leucine, L-methionine)
Emulsifiers	Allow smooth mixing of ingredients, prevent separation, keep emulsified products stable, reduce stickiness, control crystallization, keep ingredients dispersed, and to help products dissolve more easily	Salad dressings, peanut butter, chocolate, margarine, frozen desserts	Soy lecithin, mono- and diglycerides, egg yolks, polysorbates, sorbitan monostearate

(Contd.)

Table 1. Use of different chemicals as food additives (Contd.)

Ingredient	Action	Example of use	Names found on product level
Stabilizers, Thickeners, Binders, Texturizers	Produce uniform texture, improve "mouth-feel"	Frozen desserts, dairy products, cakes, pudding and gelatin mixes, dressings, jams and jellies, sauces	Gelatin, pectin, guar gum, carrageenan, xanthan gum, whey
Leavening Agents	Promote rising of baked goods	Breads and other baked goods	Baking soda, monocalcium phosphate, calcium carbonate
Anti-caking agents	Keep powdered foods free-flowing, prevent moisture absorption	Salt, baking powder, confectioner's sugar	Calcium silicate, iron ammonium citrate, silicon dioxide
Humectants	Retain moisture	Shredded coconut, marshmallows, soft candies, confections	Glycerin, sorbitol
Yeast Nutrients	Promote growth of yeast	Breads and other baked goods	Calcium sulfate, ammonium phosphate
Dough Strengtheners and Conditioners	Produce more stable dough	Breads and other baked goods	Ammonium sulfate, azodicarbonamide, L-cysteine
Firming Agents	Maintain crispness and firmness	Processed fruits and vegetables*	Calcium chloride, calcium lactate
Enzyme Preparations	Modify proteins, polysaccharides and fats	Cheese, dairy products, meat	Enzymes, lactase, papain, rennet, chymosin
Gases	Serve as propellant, aerate, or create carbonation	Oil cooking spray, whipped cream, carbonated beverages	Carbon dioxide, nitrous oxide

*Many other chemicals like waxes are used on fruits like apple in India for such purpose.

1. It does not include all the chemicals used with processed foods in the developing countries like India.

The primary food item themselves contains many food additives, preservatives and adulterants.

These are not listed, so their effects are not analyzed. Following examples may enlighten the subject.

a) Milk – a primary food item - may be adulterated with Formaldehyde, Urea, hydrogen peroxide. Ammonium sulfate, Nitrate, Benzoic acid, Salicylic acid, Borax, Boric acid, detergent, pulverised soap, coloring matter etc. (Azad and Ahmed 2016). The synthetic milk made from detergent powder is also reported. In a nationwide survey performed on 2015 by the Food safety and Standards Authority of India (FSSAI), 68.4% of milk samples were below the prescribed standards and 5.75% were adulterated with detergents (Bagla 2016). In another sample study performed in Hyderabad (India), Urea, Formaldehyde, detergent and hydrogen peroxide were found in 60%, 32%, 44% and 32% of milk (Singuluri and Sukumaran 2014). The sweets and other milk based preparations like *paneer* (cheese), *dahee* (yogurt), tea etc. are made from such milk.

b) Many of the fruits are sprayed with many pesticides, antimicrobials, antifungal, waxes etc. to protect them from spoilage.

c) Many toxic chemicals are used directly as spray or injection for ripening of fruits (as banana, mango etc.) and also vegetables (as tomato).

These primary items are used in preparation of processed foods.

2. Lack of control on the use of chemicals during preparation of food and food products

Many rules are made to control the use of toxic chemicals in food. But these are having very limited benefit to the people as the manufacturers are not kept

Table 2. Toxic food ingredients and artificial additives.

Sl.No. Additives	Use	Toxicity
A. Preservative, stabilizer, sweetener etc.		
1. Sodium nitrate	Added to processed meats to stop bacterial growth	Linked to cancer in humans - Worst Offender
2. Sulfites	Used to keep prepared foods fresh	Can cause breathing difficulties in those sensitive to the ingredient
3. Azodicarbonamide	Used in bagels and buns	Can cause asthma
4. Potassium bromate	Added to breads to increase volume	Linked to cancer in humans
5. Propyl gallate	Added to fat-containing products	Linked to cancer in humans
6. BHA/BHT	A fat preservative, used in foods to extend shelf life	Linked to cancerous tumour growth
7. Propylene glycol	Better known as antifreeze. Thickens dairy products and salad dressing. Deemed generally' safe by FDA	Toxicity includes central nervous system (CNS) toxicity, hyperosmolarity, hemolytic, cardiac arrhythmia, seizures, agitation, and lactic acidosis (Lim *et al.* 2014)*
8. Butane	Put in chicken nuggets to keep them tasting fresh	A known carcinogen
9. Monosodium glutamate (MSG)	Flavour enhancer	That can cause headaches. Linked in animal studies to nerve damage, heart problems and seizures
10. Disodium inosinate	In snack foods	Contains MSG
11. Disodium guanylate	Used in snack foods	Contains MSG
12. Enriched flour	Used in many snack foods - a refined starch	It is made from toxic ingredients
13. Recombinant Bovine Growth Hormone (rBGH)	Genetically-engineered version of natural growth Hormone in cows. Boosts milk production in cows	Contains high levels of IGF-1, which is thought to cause various types of cancer
14. Refined vegetable oil	Includes soybean oil, corn oil, safflower oil, canola oil, and peanut oil	High in omega - 6 fats, which are thought to cause heart disease and cancer**
15. Sodium benzoate	Used as a preservative in salad dressing and carbonated beverages	A known carcinogen and may cause damage our DNA
16. Brominated vegetable oil	Keeps flavour oils in soft drinks suspended	Bromate is a poison and can cause organ damage and birth defects. Not required to be listed on food labels
17. Propyl gallate	Found in meats, popcorn, soup mixes and frozen dinners	Shown to cause cancer in rats. Banned in some countries. Deemed safe by FDA
18. Olestra	Fat-like substance that is unabsorbed by the body. Used in place of natural fats in some snack foods	Can cause digestive problems, and also not healthy for the heart
19. Carrageenan	Stabilizer and thickening agent used in many prepared foods	Can cause ulcers and cancer
20. Polysorbate 60	A thickener that is used in baked goods	Can cause cancer in laboratory animals
21. Camauba wax	Used in chewing gums and to glaze certain foods	Can cause cancer and tumours
22. Magnesium sulphate	Used in tofu (coagulated Soybean milk).	Can cause cancer in laboratory animals
23. Chlorine dioxide	Used in bleaching flour	Can cause tumours and hyperactivity in children
24. Paraben	Used to stop mold and yeast forming in foods	Can disrupt hormones in the body, and could be linked to breast cancer
25. Sodium carboxymethyl cellulose	Used as a thickener in salad dressings	Could cause cancer in high quantities
26. Aluminum	A preservative in some packaged foods	Can cause cancer***
27. Saccharin	Artificial sweetener	Carcinogen found to cause bladder cancer in rats. Worst offender
28. Aspartame	Artificial sweetener	An excitotoxin and thought to be a carcinogen. Can cause dizziness, headaches, blurred vision and stomach problems

(Contd.)

Table 2. Toxic food ingredients and artificial additives (Contd).

Sl.No. Additives	Use	Toxicity
29. High fructose corn syrup	Artificial sweetener made from corn starch. Made from genetically-modified corn	Causes obesity, diabetes, heart problems, arthritis and insulin resistance
30. Acesulfame potassium	Artificial sweetener used with other artificial sweeteners in diet, sodas and ice cream	Linked to lung and breast tumours in rats
31. Sucralose	Artificial sweetener	Can cause swelling of liver and kidneys and a shrinkage of the thymus gland
32. Agave nectar	Artificial sweeteners derived from a cactus	Contains high levels of fructose, which causes insulin resistance, liver disease and inflammation of body tissues
33. Bleached starch	Artificial sweetener used in many dairy products	Thought to be related to Asthma and skin irritations
34. Tert butylhydroquinone	Artificial sweetener used to preserve fish products	Could cause stomach tumours at high doses
B, Artificial colour		
35.Red #40	Found in many foods to alter colour. All modern food dyes are derived from petroleum	A carcinogen that is linked to cancer in some studies. Also can cause hyperactivity in children. Banned in some European countries. Worst Offender
36. Blue #1	Used in bakery products, candy and soft drinks	Can damage chromosomes and lead to cancer
37. Blue #2	Used in candy and pet food beverages	Can cause brain tumours
38. Citrus red #1	Sprayed on oranges to make them look ripe	Can damage chromosomes and lead to cancer
39. Citrus red #2	Used to colour oranges	Can cause cancer if the peel is eaten
40. Green #3	Used in candy and beverages	May cause bladder tumours
41. Yellow #5	Used in desserts, candy and baked goods	Thought to cause kidney tumours, according to some studies
42. Yellow #6	A carcinogen used in sausage, beverages and baked goods	Thought to cause kidney tumours, according to some studies
43. Red #2	A food colouring	May cause both asthma and cancer
44. Red #3	It is added to cherry pie filling, ice cream and baked goods	A carcinogen, can also cause nerve damage and thyroid cancer
45. Caramel	In soft drinks, sauces, pastries and breads	When made with ammonia, it can cause Cancer in mice. Food companies not required to disclose if this ingredient is made with ammonia
46. Brown HT	Used in many packaged foods	Can cause hyperactivity in children, asthma and cancer
47. Orange B	A food dye that is used in hot dog and sausage casings	High doses are bad for the liver and bile duct
48. Bixin	Used for food colouring	It can cause hyperactivity in children and asthma
49. Norbixin	Used for food colouring	It can cause hyperactivity in children and asthma
50. Annatto	Used for food colouring	It can cause hyperactivity in children and asthma

* Also used in cold drinks. But in many cold drinks, Ethylene glycol is used in it's place, which is toxic like Arsenic (Antor 2016).
** Scientists found that heating up vegetable oils led to the release of high concentrations of chemicals called aldehydes, which have been linked to illnesses including cancer, heart disease and dementia (The Telegraph 2015).
***Also used as thin cover on some sweets instead of silver and so eaten with sweets (Times of India 2015).

under strict vigilance to follow the rules.

In India, anybody can prepare any food or food product and can sell them anywhere without having any basic idea about such food preparation, the toxicity of the chemicals used in it, effect of personal hygiene of the food handlers on food, contamination of micro organisms in openly kept food or food products and storage procedures of the prepared food.

3. Lack of consciousness of the consumers

The consciousness of common people of India (the customers) is at such a level that almost everybody

are ready to consume anything sold at the name of food, without even thinking about the quality of the food or it's items! They are not ready to even think about the hygiene of the food, food producer or the seller who sells directly the food products at open roadside stalls. They just want cheap food suppressing all the queries about the level of adulteration, quality, possible toxicity etc. inside their mind.

Requirement for study of cumulative effects of all the residual and added chemicals

The allopathic medicines, pesticide residues in the food items, the adulterants and added chemicals in the name of artificial color, flavor, stabilizing agent, emulsifying agent, chilling agent etc. as well as the toxic chemicals enter through different ways inside the body system of modern men as a part of modern lifestyle are definitely acting together during causing any effect. The same detoxifying organs and excretory organs inside our body are struggling to clear them. Without considering that point how the studies performed to determine the toxic effect of any added chemical agent can be said as complete and practical?

Shibabrata Pattanayak
Associate Editor,
Exploratory Animal and Medical Research

REFERENCES

Al-Shammari E, Bano R, Khan S, Shankity I (2014) The effect of preservatives and flavour additive on the production of oxygen-free radicals by isolated human neutrophils. Inte J Nutri Food Sci 3(3): 210-215.

Antor T (2016) Soft Drink Effects: Is soft drink really soft. [Available at http://www.careuall.com/2016/11/soft-drink-effects-is-soft-drink-really.html] Accessed on 05.11.2017.

Azad T, Ahmed S (2016) common milk adulteration and their detection techniques. Int J Food Contamination 3(22): 1-9.

Bagla P (2016) More than two thirds of the milk in India does not meet food safety standards. PTI report of 07.03.2016. (Available at http://www.thenewsminute.com/article/suspect-detergent-milk-drdos-test-kit-will-tell-you-minutes-39940, Accessed on 06.11.2017)

Codex Alimentarius Commission Procedural Manual (2013) 21th edn., 22.

IFSC and FDA (2010) Food ingredients and colors. International Food Information Council (IFIC) Foundation and US Food and Drug Administration (FDA), 1100 Connecticut Avenue, N.W., Suite 430, Washington, DC, 20036. https://www.fda.gov/downloads/Food/IngredientsPackagingLabeling/ucm094249.pdf) Accessed on 11.10.2017.

Lim TY, Poole RL, Pageler NM (2014) Propylene Glycol Toxicity in Children. J Pediatr Pharmacol Thera 19(4): 277-282.

MPH Programs List. 50 Toxic, Food Ingredients and Artificial Additives to Avoid. (Available at http://www.go2kitchens.com/wp-content/uploads/2016/09/50-Toxic-Food-Ingredients-and-Artificial-Additives-to-Avoid.pdf, Accessed on 16.10.2017.

Pattanayak S (2014) Cancer – the ultimatum of our chemical based civilization. Explor Anim Med Res 4(1): 5-7.

Sales IMS, Silva JM, Moura ESR, Alves FDS, Silva FCC, Sousa JMC, Peron AP (2017) Toxicity of synthetic flavorings, nature identical and artificial, to hematopoietic tissue cells of rodents. Braz J Biol - Ahead of print. [http://dx.doi.org/10.1590/1519-6984.07716], Accessed on 07.10. 2017.

Singuluri H, Sukumaran MK (2014) Milk adulteration in Hyderabad, India – a comparative study on the levels of different adulterants present in milk. J Chromatograph Separat Techniq 5(1): 212.

The Telegraph (2015) Cooking with vegetable oils releases toxic cancer-causing chemicals, say experts. The telegraph.07.11.2015.[Available at http://www.telegraph.co.uk/news/health/news/11981884/Cooking-with-vegetable-oils-releases-toxic-cancer-causing-chemicals-say-experts.html] Accessed on 07.10.2017.

Thomas OE, Adegoke OA (2015) Toxicity of food colours and additives: A review. Afr J Pharm Pharmacol 9(36): 900 - 914.

Times of India (2015) That silver foil on your sweet may be toxic aluminium. December 14, 2015. Available at https://timesofindia.indiatimes.com/city/hyderabad/That-silver-foil-on-your-sweet-may-be-toxic-aluminium/articleshow/50166968.cms, Accessed on 07.10.2017

World Health Organization (2017) Food additives. Fact sheet, July 2017. Available at http://www.who.int/mediacentre/factsheets/food-additives/en/, Accessed on 06.11.2017.

***Cite this article as:** Pattanayak S. (2017) Processed foods – are they safe? Explor Anim Med Res 7(2): 125-131.

Explor Anim Med Res,
Vol.7, Issue - 1, 2017, p. 05-10

ISSN 2277- 470X (Print), ISSN 2319-247X (Online)
Website: www.animalmedicalresearch.org

Editorial

ALTERNATIVE TO ANTIBIOTICS - PREPARATION FOR POST ANTIBIOTIC ERA

All the living entities of our planet are struggling continuously for their existence. Starting from the minute viruses, the fungus, bacteria, protozoa, parasites, plants and animals of various differentiated species are struggling for their existence and multiplication. In the way of such struggle, as a part of evolution, many microorganisms developed their system to secrete some antibacterial chemicals which are identified by some scientists and used as antibiotics. Due to uncontrolled use of these chemicals, the susceptible organisms get ample opportunity to alter their old systems and to develop some new system to bypass the detrimental effect of those chemicals. It is called microbial resistance. In many cases, that power of resistance is transmissible vertically among the same species and horizontally between other species of organisms (Pattanayak 2011). That ultimately causes some very serious problems like development of Superbugs-organisms resistant to all available antibiotics. Those are becoming a threat to the human civilization!

As man is the most intelligent species of the globe and wants to use all the resources for existence and multiplication of their own species, there is always a pressure to find out the means to overcome anything against such targets. To combat the problems of antibiotic resistance and for searching of alternatives of antibiotic use, various studies are going on throughout the world. The studies can be categorized in some groups.

i) Alteration and/or addition of some new chemicals with the presently available anti microbial substances to bring back their potency.
ii) Searching of some new means of attack on harmful micro organisms by use of other microorganisms or their products.
iii) Acceleration of immunity power of human or animals by using the tools present in the microorganisms.
iv) Use of some new types of substances and procedures against microorganisms which were not previously used.
v) Use of antimicrobial, immune-stimulant and other related substances developed in higher species through evolution.

i) Alteration and/or addition of some new chemicals with the presently available antimicrobial substances to bring back their potency.

Penicillins were the first group of antibiotic, and resistance against that group of antibiotic noticed first. The resistant microbes produced beta lactamase enzymes for that purpose. To overcome the problem, some chemicals (Clavulanic acid, Sulbactam, Tazobactam etc.) were added with that group of antibiotics. These chemicals are not having any anti-microbial action, but these can assist the antibiotics to overcome the resistance of the microbes. Afterwards, some other ways were searched out (bacterial efflux inhibition agents, use of analogue of antibiotics etc.) to overcome the resistance of the microorganisms (Pattanayak 2011). But ultimately it remains a common trend that after effective use for a few years, the efficacy of these alterations becomes reduced gradually due to the modification of resistance mechanism of the micro organisms. So, even continuous searching and development of such chemicals as well as prolongation of life of presently used antimicrobials, the actual efficacy of such procedures becoming shorter lasting day by day.

ii) Searching of some new means of attack on harmful microorganisms by use of other micro organisms or their products.

Antimicrobial peptides: Various plants, animals and fungi have vastly different immune systems, but all make peptides (small proteins) that can destroy bacteria. Many amphibian and reptile species developed peptides which can kill many pathogenic microorganisms. These peptides are under study for their therapeutic use as effective anti-microbial agents (Readon 2015).

The host defense peptides (small, natural peptides) and innate defense regulators (small, synthetic peptides) have indirect antimicrobial effects. They primarily act by increasing expression of anti-inflammatory chemokines and cytokines, and reducing the expression of pro-inflammatory cytokines. The anti-biofilm peptides

specifically inhibit bacterial biofilm formation have been identified and are in preclinical developmental stage. (Czaplewski *et al.* 2016).

Phage therapy: Phases are the viruses that can attack and kill bacteria. Study to use the efficacy of such viruses therapeutically against pathogenic bacteria is very old. As each type of phase generally attacks only one type of bacterium, so during clinical use all the other harmless bacteria left unharmed. As phages are abundant in nature, researchers assume to get ready replacements for any therapeutic strain that bacteria evolve to resist.

Phages secrete enzymes (lysins) to destroy the cell wall of a target bacterium and are potential replacements for antibiotics because of their direct antibacterial action, and as adjuncts because they act to reduce bacterial burden, weaken biofilms, or both. Research shows that lysins are more active against Gram-negative pathogens. Studies on the therapeutic efficacy of Wild-type bacteriophages as well as Genetically Engineered bacteriophages are going on (Czaplewski *et al.* 2016).

Bacteriocins: These are some toxins produced by microbes to inhibit the growth of similar or closely related bacteria. Bacteriocins are structurally, functionally and ecologically very diverse in nature. These can exhibit significant potency against other bacteria (including antibiotic-resistant strains), are stable and can have narrow or broad-spectrum activity. Bacteriocins can even be produced *in situ* in the gut by probiotic bacteria to combat intestinal infections (Cotter *et al.* 2013). The main bacteriocins identified from gram negative bacteria are Microcins, Colicin-like bacteriocins and Tailocins. The gram-positive bacteria derived bactericins are classified into various groups according to their size and some other characters. Nisin and other Lantibiotics are grouped under Class I. The heat stable Class II group includes a subgroup which is having very good potential for use in the field of food preservation and medical applications. Example of that subgroup is Pediocin PA-1 (Heng *et al.* 2007). Other main bacteriocins of other subgroups are Lactococcin G (Nissen-Meyer *et al.* 2009), Enterocin AS-48, Aureocin A53 (Netz *et al.* 2002), Aureocin A70 (Netz *et al.* 2001). Lysostaphin is a representative bacteriocin of Class III type (Bastos *et al.* 2010); Sublancin and Glycocin F belong to the complex type IV bacteriocin (Oman *et al.* 2011, Stepper *et al.* 2011).

iii) Acceleration of immunity power of human or animals by using the tools present in the micro organisms.

Use of antibody: Antibodies that bind to and inactivate a pathogen, its virulence factors, or its toxins were widely considered one of the alternative approaches most likely to have major clinical impact. Antibodies are considered as safe or low risk measure with a high degree of technical feasibility (Czaplewski *et al.* 2016).

Immune Stimulation: Successful antimicrobial therapy depends on impose of an appropriate immune response. Immune stimulation may be considered as a potential adjunct approach along with antibiotic therapy.

Orally used bacterial extracts are used to reduce the incidence of respiratory tract infections in some at-risk groups. Further clinical trials to substantiate their efficacy in other populations would encourage wider use. The mechanisms by which these extracts might work are unclear. Targeted interventions could be devised once these mechanisms are understood. New focused research also has been initiated on assessment of repurposed drugs for immune stimulation rather than assessment of early translational research in this specialty (Czaplewski *et al.* 2016).

Vaccination: From the time of Edward Jenner and Luis Pasteur, research related with immunization of human or animals against serious disease-causing microbes are going on with a history of huge success. The immunization procedures depend on some basic principles. It is achieved by introducing live, generally attenuated infectious agents or inactivated agents or their constituents or their products in the living body so that body protective mechanism can develop power to resist the attack of the original pathogenic micro organisms in future (Harrison 2008). But anybody can not be made immunized against each and every type of organisms which can cause disease by that method.

The long established investment in vaccines for new targets should continue to substantially reduce the incidence of infection and the need for antibiotics (Czaplewski *et al.* 2016).

iv) Use of some new types of substances and procedures against micro organisms which were not previously used.

CRISPR: It is a gene-editing technique based on a strategy that many bacteria use to protect themselves against phages. Researchers are turning that system back on itself to make bacteria kill themselves.

Normally, the bacteria detect and destroy invaders such as phages by generating a short RNA sequence that matches a specific genetic sequence in the foreign body. This RNA snippet guides an enzyme called Cas 9 to kill the invader by cutting its DNA.

Scientists are now designing CRISPR sequences that

target genomes of specific bacteria, and some are aiming their CRISPR kill switches at the bacterial genes that confer antibiotic resistance (Readon 2015).

Metals: Metals like copper and silver are the oldest antimicrobials. They were favored by Hippocrates in the fourth century BC as a treatment for wounds, and were used even earlier by ancient Persian kings to disinfect food and water. In the contemporary research, some groups are exploring the use of metal nanoparticles as antimicrobial treatments. Because metals accumulate in the body and can be highly toxic, their use may be restricted mostly to topical ointments for skin infections.

An exception is gallium, which is toxic to bacteria that mistake it for iron, but is safe enough in people to be tested as an intravenous treatment for lung infections. Pilot studies found that the metal was moderately successful at breaking down microbial biofilms in the lungs and improving patients' breathing (Readon 2015).

Probiotics: Probiotics are some selected microorganisms administered orally. These can confer a health benefit to the host when administered in adequate amounts. A defined mixture of bacteria or the use of non-toxigenic spores of *Clostridium difficile* may provide therapeutic and prophylactic therapies that can improve current clinical practice for the treatment of *C. difficile* associated diarrhea and antibiotic-associated diarrhoea (Czaplewski *et al.* 2016).

Other related studies:

Immune suppression: Bacterial infection can lead to an excessive host innate immune response (ranging from the systemic inflammatory response syndrome to septic shock), in which the injury to the host is made much worse by the host's pro-inflammatory cytokine response. Selective manipulation of this cytokine response could potentially be used in combination with antibiotics to reduce pathogen-induced tissue damage.

Anti-resistance nucleic acids: Antibiotic resistance genes are often spread by highly transmissible plasmids, particularly in Gram-negative pathogens. Effective removal of resistance genes could sensitize bacteria to conventional antibiotics.

Antibacterial nucleic acids: Use of nucleic acids to directly kill bacteria is being investigated in both academia and biotechnology companies. Studies are at an early stage. At the very least, these methods will continue to be developed to support fundamental microbial genetics studies.

Toxin sequestration using liposomes: Pathogens often secrete toxins that damage mammalian cells and cause inflammation. Administration of liposomes to act as decoys for toxin binding has been shown to reduce damage to cells and reduce disease severity.

Antibiotic-degrading enzymes to reduce selection of resistance: When antibiotics are eliminated via the gut, exposure of the normal gut bacteria to the antibiotic may lead to development of resistance and drive *Clostridium difficile* associated diarrhea or antibiotic associated diarrhea. Studies showed that oral β-lactamase can destroy β-lactams in the faeces. Demonstration of a clinical benefit of degrading enzyme administration may be challenging to the process.

Metal chelation: Bacterial pathogens need zinc, manganese, and iron ions to fully express their pathogenicity or virulence, biofilm formation, and multiple essential enzymatic and metallo-β-lactamase activities. Metal chelation could prevent these key processes in pathogens (Czaplewski *et al.* 2016).

Alphamers: Alphamers are immune modifiers consisting of a galactose-∝- 1,3-galactosyl-β-1,4-N-acetyl-glucosamine (Gal) epitope fused to a bacterial pathogen binding aptamer to redirect endogenous anti-Gal antibodies to the pathogen and enhance immune clearance.

Alphamer technology is based on chemically synthesized molecules redirecting naturally occurring antibodies to selected pathogens to fight infection. One end of the molecule binds a surface target of a pathogen cell using an aptamer, while the other end represent specific epitopes that attach the circulating antibodies.

Immune stimulation by P4 peptide: Phagocytic killing of bacteria can be enhanced by P4 peptide - a chemically synthesized 28 amino acid peptide derived from the *Streptococcus pneumoniae* surface exposed virulence factor PsaA. P4 peptide stimulates opsono-phagocytic uptake and killing in invasive disease models of *S. pneumonia* infection in mice. The combination of P4 given intra-nasally and IgG given intra-peritoneally resulted in 100% survival in the mouse model and significantly reduced bacterial burden. A therapy based on P4, IgG and antibiotic may be an effective treatment schedule in future (Czaplewski *et al.* 2016).

Predatory bacteria: Predatory bacteria can be used to control other pathogenic bacteria. Many different types of predatory bacteria have been identified, but the Bdellovibrio and like organisms (BALOs) show particular

promise. BALOs are motile Deltaproteobacteria that obligately predate Gram-negative bacteria for energy and nutrients.The genomes of many BALOs encode numerous hydrolases (e.g., DNases and proteases), essential for prey digestion and sufficient for attacking even bacterial biofilms. It is very important because biofilms pose a treatment challenge in both human and animal infections making bacteria less sensitive to antibiotics (Allen *et al.* 2014).

v) Use of antimicrobial, immune-stimulant and other related substances developed in higher species through evolution.

Presently, almost same types of antimicrobial drugs are used during treatment of various animals as well as in fishery, horticulture and other related purposes. This practice requires re-thinking. Use of antimicrobial drugs may be substituted at least partially for treatment of herbivorous animals by using juice and pieces of succulent part of medicinal plants directly (Pattanayak *et al.* 2016).

Apart from the golden treasury of texts of various ancient Indian systems of medicines, many plants and their different types of extracts, natural products etc. were recommended for their anti-microbial effects in various texts and practices throughout the world. Use of plants for antimicrobial, immune-stimulant and other related purposes are reviewed by many authors. Plants used in/ as tissue and wound healing (42 plants - Jaiswal *et al.* 2004, 36 plants - Pattanayak *et al.* 2013), antiseptic property (35 plants - Pattanayak *et al.* 2013) skin infection (175 plants - Gupta *et al.* 2010), immune-stimulant effect (13 plants -Pattanayak *et al.* 2013) are some examples.

Solvent extracted parts of many of the reported plants were tested and found to have antimicrobial activities. But in most of the cases, those plants were tested *in vitro* or on the laboratory animals mainly at local applications. On the other hand, in many websites and blogs, it is claimed that part of many plants, natural products etc. are having the power to act as alternative to antibiotics. These include the following plants, plant parts and natural products.

Aloe vera, American goldenseal (*Hydrastis canadensis*), Bearberry (*Uva ursi*), Blue flag root (*Iris versicolor*), Burdock (*Arctiuml appa*), Cayenne Pepper (*Capsicum annuum*), Chaparral (*Larrea tridentata*), Cloves (*Syzygium aromaticum*), Cryptolepis (*Cryptolepis sanguinolenta*), Echinacea (*E. purpurea* and *E. augustifolia*), Eucalyptus (*Eucalyptus globules)* oil, Garlic (*Allium sativum*), Ginger (*Zingiber officinale*), Grapefruit (*Citrus paradisi*) seed extract, Holy thistle (*Cnicus benedictus*), Honey, Horseradish (*Armoracia rusticana*), Juniper (*Juniperus communis*), Licorice (*Glycyrrhiza glabra* and *G. uralensis*), Lobelia (*Lobelia cardinalis*), Mullein (*Verbascum thapsus*), Myrrh (*Commiphora myrrha*), Nasturtium (*Tropaeolum majus, T. peregrinum* and *T. speciosum*), Oregano Oil (*Origanum vulgare*), Poke root (*Phytolacca decandra*), Red clover (*Trifolium pretense*), Sage (*Salvia officinalis*), Thyme (*Thymus vulgaris*), Usnea (*Usnea spp.*), Wild indigo *(Baptisia australis*), Wild thyme (*Thymus serpyllum*), Wormwood (*Artemisia absinthium*), Cranberry (*Vaccinium oxycoccos, V. macrocarpon*) juice (foodmaster.com), Sida (*Sida acuta*), Alchornea (*Alchornea cordifolia*), Bidens (*Bidens pilosa*), Artemisia (*Artemisia annua*), Black pepper (*Piper nigrumand, P. longum*) (Buhner 2011), Olive (*Olea europaea*) leaf extract, Yin Chiao (Chinese Herbal Remedies), Epi Cor (dried fermentate of *Saccharomyces cerevisiae*), Elder berries (*Sambucus nigra*) (Mindell and Hopkins 2009), Coconut (*Cocos nucifera*) Oil, *Forsythia suspensa* (Sisson 2011). Oregon Grape (*Berberis aquifolium*), *Andrographis paniculata,* Manuka honey (European honey bees foraging on *Leptospermum scoparium*) (LoGiudice 2011), Onion (*Allium cepa*), Turmeric (*Curcuma longa*), Cinnamon (*Cinnamomum verum*) , Cardamon (*Elettaria cardamomum*), oils of Basil (*Ocimum basilicum*) and Lavender (*Lavandula angustifolia*) (Harrington 2015), Pau d'Arco (*Tabebuia impetiginosa*) tea, (www.naturalsociety.com), Propolis (Bee glue), Sangre de Drago (bright red resin of *Croton lechleri*) (Stephanie 2015) etc.

The antimicrobial chemicals developed in various species of plants are also a part of evolutionary outcome of the struggle for their existence. It can be assumed that the mechanism of actions of the antibacterial substances of herbal or other uncommon origin is different than the presently used anti microbial substances. So it can be expected that the targeted micro organisms will have to get accustomed with such diverse types of molecules before developing resistance as a part of their struggle for their existence.

Even if we can get success in overcoming the dominance of infective organisms, the following points demand more serious consideration for prevention of repetition of development of such crucial conditions in future.

i) A change is required in our consideration of antibacterial substances as an alternative of the minimum disease protective requirements like good hygienic practices, adequate public health awareness, creation of micro organism free apparatus and environment in the institutions delivering medical supports to the patients, unhealthy surroundings of human dwellings and habitations etc. As an example, it can be said that change of poor living conditions and unhygienic environment of

the slums should be considered far more important rather than the use of anti microbial substances to treat the preventable bacterial diseases of the slum dwellers.

ii) Reconsideration is needed in the fields like use of same antimicrobial substances in different species of animals, birds, fishes etc. for treatment of diseases as well as use of those in agricultural or horticultural operations to control microbial infections. Some anti-microbials may be considered as 'stock' for every species of animals and plants.

iii) As some alternative, maximum efforts may be given to use biological resources and to make provision of biological controls. Different medicinal plants/ plant extracts may be used for curing of ailments of herbivorous animals. Toxic plant parts or their component may be studied to use as biological medicines in agriculture and horticulture. Elaborative research targeting such goal is needed.

iv) Maintenance of proper hygienic practices and nutrition level, decrease in the rate of entry of different types of toxins in the body directly through food or indirectly through food chain, immunization and immune stimulation through herbal medication may be strengthened to reduce the pressure of use of antimicrobial substances in every related sector.

Shibabrata Pattanayak
Associate Editor,
Exploratory Animal and Medical Research

REFERENCES

Allen HK, Trachsel J, Looft T, Casey TA (2014) Finding alternatives to antibiotics. Ann. N.Y. Acad. Sci. 1323: 91-100.

Bastos MCF, Coutinho BG, Coelho MLV (2010) Lysostaphin: a Staphylococcal bacteriolysin with potential clinical applications. Pharmaceuticals 3(4): 1139-1161.

Buhner SH (2011) Herbal antibiotics. Storey Publishing, LLC.

Cotter PD, Ross RP, Hill C (2013) Bacteriocins - a viable alternative to antibiotics? Nature Reviews Microbiol 11(2): 95-105.

Czaplewski L, Bax R, Clokie M, Dawson M, Fairhead H, Fischetti VA, Foster S *et al.* (2016) Alternatives to antibiotics - a pipeline portfolio review. Lancet Infect Dis 16: 239-251.

Harrison (2008) Harrison's Principles of internal medicine (17 th edn.) Chapter 116. The McGraw-Hill Companies, Inc. U.S.A.

Heng CKN, Wescombe PA, Burton JP, Jack RW, Tagg JR (2007) The diversity of bacteriocins in Gram-positive bacteria. In: Bacteriocins: Ecology and Evolution (2007). 1st edn. Riley MA and Chavan MA, Eds. Springer, Hildberg. 45-83.

Jaiswal S, Singh SV, Singh B, Singh HN (2004) Plants used for tissue healing inanimals. Nat Prod Rad 3(4): 284-290.

Gupta A, Nagariya AK, Mishra AK, Bansal P, Kumar S, Gupta V, Singh AK (2010) Ethno-potential of medicinal herbin skin diseases: an overview. J Pharm Res 3(3): 435-441.

Netz DJ, Beck-Sickingera PG, Pierik S, Sahl HG (2002) Biochemical characterisation and genetic analysis of aureocin A53, a new, atypical bacteriocin from *Staphylococcus aureus.* J Mol Biol 319: 745-756.

Netz DJ, Nascimento S, Soares O, Bastos MCF (2001) Molecular characterisation of aureocin A70, a multiple-peptide bacteriocin isolated from *Staphylococcus aureus.* J Mol Biol 311: 939-949.

Nissen-Meyer J, Rogne P, Oppegård C, Haugen HS, Kristiansen PE (2009) Structure-function relationships of the non-lanthionine-containing peptide (class II) bacteriocins produced by gram-positive bacteria. Curr Pharm Biotechnol 10: 19-37.

Oman TJ, Boettcher JM, Wang H, Okalibe XN, Van der Donk WA (2011) Sublancin is not a lantibiotic but an s-linked glycopeptide. Nat Chem Biol 7(2): 78-80.

Pattanayak S (2011) Development of resistance in bacteria against Anti - microbial agents: reasons, threats and ongoing encounter. Explor Anim Med Res 1(1): 07-19.

Pattanayak S, Maity D, Mitra S, Debnath PK, Mandal TK, Bandyopadhyay SK (2013) Use of fresh parts of medicinal plants for health and production in livestock - a new concept of farming. Explor Anim Med Res 3(1): 07-16.

Pattanayak S, Mandal TK, Bandyopadhyay SK (2016) Validation and therapeutic use of succulent plant parts - opening of a new horizon of alternative medicine. Explor Anim Med Res 6(1): 08-14.

Readon S (2015) Bacterial arms race revs up. Nature 521: 402-403.

Stepper J, Shastri S, Loo TS, Preston JC, Novak P, Man P, Moore C H, Havlicek V, Patchett ML, Norris GE (2011) Cysteine s-Glycosylation, a new post-translational modification found in glycopeptide bacteriocins. FEBS Letters 585: 645-650.

Website Browsing:

Harrington R (2015) What are the most effective antibiotics? (Accessed from http://naturalsociety.com/what-are-the-most-effective-natural-antibiotics/ on 22.01.2017).

LoGiudice P (2011) Herbal Antibiotic Alternatives. (Accessed from http://www.doctoroz.com/article/herbal-antibiotic-alternatives on 06.01.2017).

Mindell, EL, Hopkins V (2009) Prescription Alternatives. The McGraw-Hill Companies, Inc. U.S.A. Downloaded as Natural Alternatives to Antibiotics, from ShareGuide.com. (Accessed from http://www.shareguide.com/alternatives.html on 14.01.2017).

Sisson M (2011) The Problems with Antibiotics: Possible Alternatives and Damage Control. Accessed from http://www.marksdailyapple.com/the-problems-with-antibiotics-possible-alternatives-and-damage-control/ on 16.01.2017).

Stephanie (2015) Natural alternative to antibiotics. (Accessed from http://www.happyherbcompany.com/natural-alternatives-antibiotics on 09.01.2017).

http://www.foodsmatter.com/natural_medicine_comp_therapies/miscellaneous/articles/altern_antibiotics.html (Accessed on 12.01.2017)

***Cite this article as:** Pattanayak S (2017) Alternative to antibiotics - preparation for post antibiotic era. Explor Anim Med Res 7(1): 05-10.

Explor Anim Med Res,
Vol.6, Issue - 1, 2016, p. 5-7

ISSN 2277- 470X (Print), ISSN 2319-247X (Online)
Website: www.animalmedicalresearch.org

Editorial

SLOW POISONING THROUGH WATER INTAKE -- ARE WE CONSCIOUS?

Pollution of water is a topic of research to many scientists working in various fields. But the quality of water actually available for drinking and cooking to most of the people residing in rural India is not given proper attention. Water from the natural water bodies like river, canals etc. are not generally used directly for drinking purpose now - a - days, as many of our rural people are having some knowledge about the pollution level of those resources. Same may be applicable about the stagnant water of agricultural fields, particularly of lowland areas during rainy season. People rely upon the underground water resources including well water for drinking. Well water at rocky, sandy or lateritic soil area and stagnant pond water at clay-rich or loamy soil area is used as a media of cooking. It is a very common notion that these water sources are safe. If we analyze the whole matter critically, it appears that all the above perceptions are completely wrong!

As per the updated research, the main pollutants mixes with water can be listed.

1. Synthetic organic pollutants:

a) Detergents used for laundry and other washing purposes.

b) Pesticides used agriculture and other related purposes.

c) Slow degradable fertilizers used in agriculture.

d) Polychlorinated Dibenzodioxins (PCDDs) and Polychlorinated Dibenzofurans (PCDFs), the by-products in the manufacture of some herbicides and pesticides.

e) Polychlorinated biphenyls (PCBs), one of the most hazardous human made substances extensively used in manufacture of transformers, capacitors, hydraulic fluids, lubricating oils, paints, adhesive resins, inks, fire retardants, wax extenders etc. as excellent insulating and cooling fluids.

f) Different types of chemicals used by people as a part of modern life style which ultimately reach the water resources through different ways.

2. Inorganic pollutants:

a) Heavy metals – Cadmium (from pigment works, textiles, electroplating chemical plants); Lead (from various industries, mining, leaded gasoline); Mercury (from Industry of paint, paper, chlorine, caustic soda, fertilizers, pesticides); Chromium (from plating operations, aluminum anodizing, paint and dye operations including textile dyeing, leather industries, ceramic and glass industry, photography); Arsenic (vacuum in underground water layer releases it) etc.

b) Other inorganic pollutants – Cyanide (from metal cleaning and electroplating industry); Ammonia (from microbial degradation of decaying biomass and organic matter); Hydrogen sulfide (from chemical plants, paper mills, textile mills and tanneries); Nitrate nitrogen (from industrial wastes); Sulfite ion (industrial wastes) etc.

3. Eutrophication and algal nutrients: Decay of gathered excess organic substances cause unsightly green slime layer over the surface of water body.

4. Acid mine drainage: Coal mines, specially the abandoned mines release sulphuric acid and iron hydroxide into the streams.

5. Accumulation of salts in water: Evaporation of water in irrigated agriculture cause accumulation of salts on the soil surface which reach the water bodies.

6. Oxygen sag curve formation: With the introduction of polluted water loaded with organic matters into the river, the dissolved oxygen content in the water body rapidly gets depleted and it cannot support higher forms of aquatic life. It can be graphically represented as a curve.

During rainy season, the lodged water of agricultural fields is contaminated with different types of pollutants. This water is allowed to enter in the pond for storage. This stored water is used in different household purposes during other seasons. Washing of garments and utensils by detergent mixtures, bathing of human and domestic animals, use of feed materials for fishes etc. are performed regularly in the pond water. Water of these ponds reduces in volume gradually due to evaporation and use. The concentrated mixture of cumulatively accumulated chemicals in the pond water is taken indirectly as it is regularly used in the purposes like boiling of rice, preparation of curry etc.

Most of the canals are connected with rivers and carry at least partially the drained water of the catchment area and the water of the rivers. In many places, this water is used in the same purposes like pond water.

The water level of wells of rural India raise at a satisfactory level during the rainy season only. This is due to leaking of the water from the adjacent plot of agricultural operation, where different types of pesticides and fertilizers are constantly used. This well–water also become reduced in volume gradually and the materials inside it become concentrated. This water is also used during rest of the year for drinking, cooking and other related purposes.

Not only by arsenic or fluoride contaminated underground water in many places of rural India, but through intake of the surface water of ponds, canals and wells, a large number of rural Indians are getting slow poisons daily.

This major problem warrants further study.

Dr. S.Pattanayak
Associate Editor,
Exploratory Animal and Medical Research

REFERENCE

1. Subramanian MS. Environmental Chemistry and analysis.Module 1.3:Water Pollution. Indian Institute of Technology, Madras. Web: nptel.ac.in/courses/IIT- MADRAS/ Environmental_chemistry_Analysis/Pdfs/1_3.pdf (Downloaded on 01.01.2016).

***Cite this article as:** Pattanayak S (2016) Slow poisoning through water intake - are we conscious? Explor Anim Med Res 6(1): 5-7.

Explor Anim Med Res,
Vol.5, Issue - 2, 2015, p. 117-119

ISSN 2277- 470X (Print), ISSN 2319-247X (Online)
Website: www.animalmedicalresearch.org

Editorial

INCOMING WATER CRISIS IN INDIA : AS UNDERSTOOD BY OTHERS

The incoming water crisis of our country is not a serious or hot topic of discussion in any section of our society. But like many other important aspects, a good number of conscious people residing outside India are trying to find out the actual reasons, possible outcome and ways to combat the situation. Some of their findings are very interesting and can lead our policy makers to accept some appropriate decisions. We can share some of such explanations.

As per one report of UNICEF on use of Indian water, a constant competition will be started very soon over water between the families engaged in agricultural practices and the urban habitats, the industrialists and the environmental conservationists, minorities depended on natural resources and entrepreneurs seeking to commodity the resources base for commercial gain.

According to a report of the National Bureau of Asian Research, Wasington, USA, India's water crisis is mainly rooted in three causes. The first is the very rapid population growth, which leads to availability of insufficient water per person. As per the 2011 census, India is having a population load of 1.2 billion, who are having only 1,000 cubic meters of water per person. India had between 3,000 and 4,000 cubic meters of water per person in 1951. A country is considered water-stressed if it has less than 1,700 cubic meters per person per year. On the other hand, United States has nearly 8,000 cubic meters per person today. So condition is easily understandable.

According to the same report, "the second cause is poor water quality resulting from insufficient and delayed investment in urban water-treatment facilities. Water in most rivers in India is largely not fit for drinking, and in many stretches not even fit for bathing. Despite the Ganga Action Plan, which was launched in 1984 to clean up the Ganges River in 25 years, much of the river remains polluted with a high coli form count at many places. The facilities created are also not properly maintained. Moreover, industrial effluent standards are not enforced because the state pollution control boards have inadequate technical and human resources."

The third main cause of water crisis of India was analyzed as "dwindling groundwater supplies due to over-extraction by farmers. This is because groundwater is an open-access resource and anyone can pump water from under his or her own land. Given how highly fragmented land ownership is in India, with millions of farmers and an average farm size of less than two hectares, the tragedy of the commons is inevitable. India extracted 251 bcm (billion cubic meters) of groundwater in 2010, whereas the United States extracted only 112 bcm. Further, India's rate of extraction has been steadily growing from a base of 90 bcm in 1980, while this rate in the United States has remained at more or less the same level since 1980".

Irrational and indiscriminate use of water resources in India is described in an article of New York Times as "since independence, India's primary goals have been economic growth and food security, completely disregarding water conservation. This has caused serious ramifications being felt today, as many citizens

still operate under these principles. Unlike many other developing countries, especially those with acute water scarcity issues such as China, Indian law has virtually no legislation on groundwater. Anyone can extract water: homeowner, farmer or industry as long as the water lies underneath their plot of land".

As per one World Bank Report, "Due to the amenities of typical urban life, such as flush toilets and washing machines, people living in cities tend to lead more water intensive lives. The urban population has doubled over the past 30 years, now representing 30% of India's total population". It is postulated in the report that the urban population in India is expected to reach 50% of the total population by 2025. Population growth is going to accelerate the water crisis in India, especially as more and more people move into the cities and become part of the middle class. Because the rivers are too polluted to drink and the government is unable to consistently deliver freshwater to the cities, many urban dwellers are turning to groundwater, which is greatly contributing to the depletion of underground aquifers.

According to the United Nations World Water Development Report (2015), coastal cities such as Calcutta, Dhaka, Jakarta and Shanghai are already experiencing saltwater intrusion in groundwater supplies due to uncontrolled groundwater abstraction as a result of the inadequacy of public water supply systems. This problem has some definite trend to increase with time.

According to another report of New York Times, "India's water crisis is predominantly a manmade problem. India's climate is not particularly dry, nor is it lacking in rivers and groundwater. Extremely poor management, unclear laws, government corruption, and industrial and human waste have caused this water supply crunch and rendered what water is available practically useless due to the huge quantity of pollution".

So, a combination of improper disposal of sewage and industrial effluents, gathering of a part of pesticides and fertilizers used in farming practices make Indian surface water unfit for use in many cases. Accumulation of chemicals like arsenic, fluoride as well as detergent in the underground water due to lifting of water at a very fast rate making it unfit for consumption. Moreover, the storage depletion rate of underground water is so high that can lead to fight between different groups.

What are the alternatives....?

According to Brooks (2007), "the tragedy of India's water scarcity is that the crisis could have been largely avoided with better water management practices. There has been a distinct lack of attention to water legislation, water conservation, efficiency in water use, water recycling, and infrastructure. Historically water has been viewed as an unlimited resource that did not need to be managed as a scarce commodity or provided as a basic human right. These attitudes are changing in India; there is a growing desire for decentralized management developing, which would allow local municipalities to control water as best needed for their particular region."

"An immediate solution to India's water crisis is to change water management practices by regulating usage with effective legislation. However, as previously mentioned, there is significant opposition to raising electricity tariffs, and there would most likely be even more resistance to enacting tariffs on water itself."

"India is also considering large-scale engineering projects, similar to those adopted in China. The most talked about project is the $112 billion Interlinking of Rivers project. This project will link all 37 rivers by thousands of miles of canals and dozens of large dams. This project is intended to increase the amount of water available for irrigation and would add 34,000 mw of hydropower to the national pool. Civil society organizations and traditional water managers have dismissed the ILR because it has the potential for stirring international conflicts, by reducing the water that flows to bordering countries, such as Bangladesh. In

addition, ILR is expensive, will most likely face the same fate as India's dams: broken and inefficient due to lack of maintenance and reinvestment."

We may start thinking.

Dr.S.Pattanayak
Associate Editor,
Exploratory Animal and Medical Research

REFERENCES

Anand G (2005) "Water-scarce India, too, Weighs a Return to Ancient Practices." International Herald Tribune, 20 Aug 2005. Cited by Brooks N (2007) Imminent Water Crisis in India. http://www.arlingtoninstitute.org/wbp/global-water-crisis/606.

Brooks N (2007) Imminent Water Crisis in India. http://www.arlingtoninstitute.org/wbp/global-water-crisis/606.

India's water crisis: causes and Cures. The National Bureau of Asian Research , 1301 Pennsylvania avenue, Suite 305, Washington, D.C. 20004 USA. Report published on august 2013.

"India's Population to Reach 1.5 Billion by 2025" http://www.dnaindia.com/report.asp? NewsID=1109284.

India: Water Supply and Sanitation – UNICEF Study (2002), 31. Cited by Brooks N (2007) Imminent Water Crisis in India. http://www.arlingtoninstitute.org/wbp/global-water-crisis/606.

Sengupta S (2006) "In Teeming India, Water Crisis Means Dry Pipes and Foul Sludge." New York Times, September 29, 2006.

Sengupta S (2006) "India Digs Deeper, but Wells Are Drying Up." New York Times, September 30, 2006. Cited by Brooks N (2007) Imminent Water Crisis in India. http://www.arlingtoninstitute.org/wbp/global-water-crisis/606.

The United Nations World Water Development Report, 2015. Water for a sustainable world. Chapter 12 : Asia and pacific. 74-77.

World Bank Report, India's Water Economy: Bracing for a Turbulent Future (2005),http://www.worldbank.org.in/WBSITE/EXTERNAL/COUNTRIES/SOUTHASIAEXT/INDIAEXTN/0,contentMDK:20668501~pagePK:141137~piPK:141127~theSitePK:295584,00.html.

***Cite this article as:** Pattanayak S (2015) Incoming water crisis in India: as understood by others. Explor Anim Med Res 5(2): 117-119.

Explor Anim Med Res,
Vol.5, Issue - 1, 2015, p. 7-9

ISSN 2277- 470X (Print), ISSN 2319-247X (Online)
Website: www.animalmedicalresearch.org

Editorial

WASTAGE OF UNDERGROUND WATER - STEPS TOWARDS A TRAP?

Many scientists presume that our planet may have to face the third world war, which will be due to the fight for capture of water resources. The underground water resources are declining day by day and under many town and cities, the water level is declining at a very rapid rate due to imbalance of withdrawal and recharging by leaking of surface water through pervious layer of soil. Urbanization, particularly in the thickly populated countries like India, is not a planned subject and so nobody bother about utility of natural surface water resources. The effects of building of high-rises after filling of surface water resources like ponds and use of underground water for all type of construction purposes are having serious impact on recharge as well as quick depletion of underground water. Use of underground water for all the purposes like bathing, washing of garments and vehicles, use as flush in toilet etc. in urban areas by billions of people every day is also having a very serious impact on underground water store. In the Indian cities like Hyderabad or Chennai, many people are totally dependent on bottled/canned water sold by multinational companies for drinking and other household purposes. During such bottling, a huge amount of underground water becomes lost in the bottling processes. Many cities and towns are approaching to reach this condition very soon.

In a hot and humid country like India, many people were traditionally accustomed to take bathe in surface water sources like ponds, lakes or rivers. Same water source was used by many people for many purposes and water was not lost. This traditional system is at the way of total replacement by the western system where underground water is used and it is used only for once! Copy of such system from the cold countries where people seldom bathe to our hot, humid country, and intention to spread of this idea to even the villagers in the name of modernization is definitely questionable. The concentration of people and difference in *per capita* use of water in so called developed and developing country may also be considered.

Requirement of supply of drinking water through pipe is very important in some rural areas of our country. Yet, it is not so important or even not at all important in some other areas. The traditional hand pump for drinking water is sufficient for many places. Perhaps our experts like to think that our country is having uniform or identical agro-climatic condition. As like the culture, religion, social concepts etc., the requirement of water at household purposes also differs among districts, subdivisions or even among the villages inside the same block! Without considering such variables, how a good plan can be made?

Fig.1. An ever open tap of water supplying line in a village of West Bengal, India.

Fig.2. Modern forward osmosis desalination plant at Al Khaluf, Oman. (http://en.wikipedia.org/wiki/file:Modern _Water_FO_Plant_AI_Khaluf_Omam.jpg)

Anybody can find many villages in new alluvial zone where a huge number of ponds are available, the open water supplying taps (remain always open to control water pressure during supply of water) are throwing water constantly and nobody is there to take it. It may be found in almost all the supply periods of the day generally during the months from July to February. We are destroying one of our very important resources in that way.

Many villagers are already made sufferer of serious health problems due to consumption of Arsenic and Fluoride through drinking of underground water. This is due to the mixing of those chemicals with underground water for creation of vacuum in water layer beneath the soil. Use of underground water for cultivation of huge water consuming grains (like paddy in the dry winter season!) as directed by our famous "Green Revolution" was mainly responsible for this. Unnecessary loss of a huge amount of underground water is strengthening the problem.

Another important way of unnecessary water loss is the cold drinks manufacturing factories. How many of us know that loss of what amount of water can only give us a bottle of cold drink? Loss of water for such a purpose is called as the water footprint. The water footprint of the so called cold drink or soft drink is of 150 to 300 liter of water per 500 ml (half of a liter) bottle!

The cold drink factories cause depletion of underground water so rapidly that within five or six years of establishment of such a factory, the hand pumps of nearby area fail to function. Same type of observation can be found in the surrounding areas of mineral water plants.

The question is - what will be the alternative? Is there at all any alternative?

Some alternatives are already in our hand and they are already in use in some parts of our planet. We may select crops with lower level of water consumption during dry months and can create natural reservoir of rain water like pond or lake near the low rainfall areas. On the other way, we may use the Forward Osmosis procedure to get potable, wholesome very good quality drinking water from the salty sea water. Forward osmosis (FO) is an osmotically driven membrane bound process that uses osmotic pressure of concentrated solutions, including seawater, to extract clean water. This technology is very much with us, and it is already successfully implemented in some parts of our planet.

Then what is the problem in its use?

Involvement of a good amount of money is definitely required for establishment of such type of plant. The Cold drinks or bottle water manufacturing companies are not interested in this alternative as that may reduce their profit. But why our policy makers are not interested?

Dr.S.Pattanayak
Associate Editor,
Exploratory Animal and Medical Research

REFERENCES

Ali Altaee (2012) Forward Osmosis: Potential use in Desalination and Water Reuse. J. Membr. Separat.Tech. 1(2): 79-93

Ercin A E, Aldaya M M, Hoekstra A Y (2011) Corporate water footprint accounting and impact assessment: The case of the water footprint of a sugar-containing carbonated beverage, Water Resources Management 25(2): 721-741.

Hoekstra A Y, Chapagain A K, Aldaya M M, Mekonnen M M (2011) The water footprint assessment manual: Setting the global standard, Earthscan, London.

Tzahi Y. Cath, Jörg E. Drewes, Carl D. Lundin, Nathan T. Hancock (2010) Forward Osmosis–Reverse Osmosis Process Offers a Novel Hybrid Solution for Water Purification and Reuse.IDA journal (www.idadesal.org). 16-20.

*** Cite this article as**: Pattanayak S (2015) Wastage of underground water - steps towards a trap? Explor Anim Med Res 5(1): 7-9.

Explor Anim Med Res,
Vol.4, Issue - 1, 2014, p. 5-7

ISSN 2277- 470X (Print), ISSN 2319-247X (Online)
Website: www.animalmedicalresearch.org

Editorial

CANCER – THE ULTIMATUM FROM OUR CHEMICAL BASED CIVILIZATION

A report has been published by the Macmillan Cancer Support of London in BBC News that 47% of the British will get cancer in their lifetime by 2020. Cancer rate could be increased by 50% to 15 million new cases in the year 2020 as the report of WHO. In the year 2000, malignant tumors were responsible for 12 per cent of the nearly 56 million deaths worldwide from all causes. More than a quarter of deaths are attributable to cancer in many countries. But it is clearly evident from the report that healthy lifestyle and public health actions could change this trend and could prevent as many as one third of cancers worldwide.

It is observed that every year about 8 lakhs new cancer patients get registered with the National Cancer Registry Programme in our country. The Crude Incidence Rate (CIR) for Cervix cancer, Breast cancer and Oral cancer is 21.3, 17.1 and 11.8 per lakh population respectively, according to the National Commission on Macroeconomics and Health (NCMH 2005).

The NCMH epidemiological studies also reveal that 70-90% of all cancers are environmental among which lifestyle related factors are the most important. Dietary practices, reproductive and sexual practices etc. account for 20-30% of cancers. Consumption of Tobacco, diet with high fat and high calorie and low fiber, low physical activity, consumption of alcohol etc. act along with some genetic factors in the way of initiation of cancer.

These reasons are common in almost everywhere of our planet and perhaps known to at least every educated person of our country. Apart from these common causes, some other factors may play some very important role in this process, particularly in the third world countries like India. Residues of pesticides, fertilizers, detergent, colorants and thousands of such other chemicals mix with surface water, enter in the food chain and afterwards reach the underground water by leaking. Regular consumption of these chemicals and also chemicals like Arsenic, Fluoride etc. through drinking water, consumption of very toxic chilling agent, 'Ethylene glycol' and many other chemicals with the cold drinks, leaked toxins of plastic cup containing hot beverages, bottles and sachets containing food and drink items definitely play many important roles.

We, the new generation of Indians are avoiding old cereal based home made food and becoming habituated to take food most of which are prepared by frying food items and adding with different spices. We are not having any report on the quality of oil or the spices used in our so called street restaurants, hotels, festive food suppliers etc. There are ample chances of getting a lot of toxic chemicals with fast food at road side. The quality of tomato sauce added, nature of frying media (oil?) used during preparation of fried food, which remain solid even at hot summer and having a color of coal tar for repeated boiling at very high temperature, other synthetic flavoring and coloring agents used to prepare famous cheap foods like Kachwri, Biriani, Moglai, Egg roll, Samosa, Fish fry, Chicken pakora, Paneer pakora, Phuchka, Alukabli, Pampri-chat and other fried food are highly suspicious. On the other hand, chemicals used as various adulterants in the basic items used for vehicle and frying (wheat flour, gram chuni, spices, oil etc.) and the basic items obtained from animal produces (paneer, fish, meat etc.), use of added artificial colors, preservatives from paraffin to hundreds of other chemicals in some other basic items in the steps of production, preservation, storage, transportation and sale (fruits, vegetables, cereals) as well as other chemicals used during preparation of food (flavoring and emulsifying agents etc.) in all ready to eat food may be far above than the recommended dose or number, if properly measured.

Toxic effect of Monosodium glutamate among Chinese foods and Acrylamide in Chips are known to us as these are known and studied, but effect of some mixtures of different toxic chemicals in the name of food/food items (like milk products made from the milk with adulterant from urea to formaldehyde up to detergent based synthetic milk!) may have some dramatically different health impact than the reports found in the internet!

Indians have a definite attraction for sweets. Sweets are a part of our social and devotional rituals. The sweet shops use milk and milk products, and also prepare some other sweets with the basic items like gram chuni or wheat flour. We get reddish Gulbjamun, very deep yellow Jilabi, red Amriti, deep green and deep red Bundia inside the deep yellow Bundia and so on. We never bother about the colorants used in these famous sweets. In the rural areas, locally made sweetened ice and toffee of different color and smell are sold in different names and regularly taken by the children. In rural India, the easily available cheap colorants are used for coloration of food items. Cheap toxic colorants used during color festival *Holi* are detected by some Indian researchers in sweets! How toxic they are for our health after consumption? Children are the main eater of these food items. We are not aware of the colors used in these food items as the reports are not found in the media.

We can find a huge number of Soda shops in each and every city and towns of India. People, mainly children are fond of these cold drinks which may be of any color and any fruit flavor and costing only Rs. 5.

Life of almost all modern Indian starts with a cup of tea, which may have odor of synthetic origin, and may contain insecticides and the plastic cup may add some more poisons in the hot tea! We are accustomed with the use of different foods, drinks, huge number of cosmetics, from body spray to hair and body colorants, self selected allopathic medicines etc. as a part of our modern lifestyle. It can be easily assumed what number and what varieties of chemicals enter in our body every day. Like all other machinery, our liver and kidney have also a limitation in the power of clearance of such chemical load. These vital organs may be affected and also many and much of these chemicals may be accumulated inside different tissues of our body. Thus, the cumulative effect of regular consumption of low amount of a large number of synthetic chemicals may create ultimately an environment inside our body leading to gereration of several types of diseases. Moreover, either DNA molecule of some tissue may get irreversible genetic damage or mutations or some tissue may start to grow abnormally due to the effect of those chemicals, both of which can lead to cancer, slowly but inevitably.

To live with lesser number of hazardous diseases and for a healthy future generation, we must have to be conscious about these dangerous aspects of our chemical based civilization.

Dr.S.Pattanayak

Associate Editor
Exploratory Animal and Medical Research

***Cite this article as:** Pattanayak S (2014) Cancer – the ultimatum of our chemical based civilization. Explor Anim Med Res 4(1): 5-7.

Explor. Anim. Med. Res.,
Vol.3, Issue - 2, 2013, p. 93-94

ISSN 2277- 470X (Print), ISSN 2319-247X (Online)
Website: www.animalmedicalresearch.org

Editorial

HUMAN HEALTH IMPACT OF BOVINE BETA-CASOMORPHIN-7 OF MILK — A QUESTION FOR MILK PRODUCTS OR OUR BREEDING POLICY ?

Beta-casein comprises around 30% of the total protein contained in cow's milk. Beta-casein may be present as one of the two major genetic variants, A_1 and A_2 in cattle. Although there are at least 13 different variants of the beta-casein protein in cattle population, with any one cow producing milk that will contain either one or two of these 13 variants. The A_1 beta-casein variant releases one opioid peptide Beta-Casomorphin-7 (BCM-7) following normal enzymatic digestion which acts as a histamine releaser, whereas A_2 beta-casein generally does not release it. The major difference between the A_1 and A_2 beta-casein proteins found in a single amino acid at position 67 in a strand of 209 amino acids. A_1 beta-casein has the amino acid histidine at position 67, while A_2 beta-casein is having a proline amino acid in the same position. The bovine beta-casein gene is part of a cluster of 4 casein genes (alpha-S_1-casein, alpha-S_2-casein, beta-casein and kappa-casein) located on chromosome number six. Release of BCM-7 from the hydrolyzed raw or processed milk is related to the beta-casein A_1 allele, irrespective of a lactation period. Processing of raw milk at high temperatures is having only a little effect.

Human milk, goat milk, sheep milk and milk of other species contain beta-casein which is 'A_2 like', as they have amino acid proline at the equivalent position in their beta-casein amino acid chains. The A_1 beta-casein protein derived BCM-7 can affect many opioid receptors in the endocrine, nervous and immune system. Infants are having more chance of absorption of BCM-7 through their comparatively immature gastro-intestinal tract than the adults who are having a chance of showing local reaction in the intestine.

BCM -7 is also considered to be an oxidant of Low Density Lipoprotein (LDL) which may have some role in formation of arterial plaque. It is reported that BCM-7 may function as an immunosuppressant and impair tolerance to dietary antigens in the gut immune system which may contribute to the onset of Type 1 Diabetes. BCM-7 has been implicated as a **potential etiological factor in Type 1 Diabetes mellitus, Coronary Heart Disease, Arteriosclerosis, Sudden Infant Death Syndrome and also related with some neurological conditions such as Autism or Schizophrenia.** A_2 beta-casein has not been implicated for these conditions.

Existing cattle population are identified as two separate species: *Bos taurus*, the European

or “taurine” cattle (including similar types from Africa and Asia) and our native *Bos indicus*, the “*zebu*”, most of which are referred as “ *Deshi*”, or “*Non descriptive*” cattle.

A_2 beta-casein is found in all Western, African and Indian cattle and water buffalo. A_1 beta-casein is carried only by the cows of European breeds, all of which belong to the subspecies *Bos taurus*. Beta-casein allele frequency in indigenous Indian cattle (*Bos indicus*) and buffalo breeds reported to have 99 to 100% presence of the A_2/A_2 genotype and A_1/A_1 genotype is absent among them. So, almost all the indigenous Indian cow and buffalo breeds are homozygous for the A_2 beta-casein allele. The picture is different among European breeds. The Holstein carries the A_1 and A_2 beta-casein alleles almost in equal distribution. Jersey has an A_2 allele frequency somewhat higher than this. But some Jersey cows carry one “B” beta-casein allele which can release of BCM-7 far more.

So, we can at least safely conclude that the milk of our native cow is far safer than the milk of Jersey or such other Europian breed of cattle. A breed is developed by exercising continuous selection pressure on a particular type of animal showing desirable characteristics for long generations. The characters are identified considering several factors including the conditions of a geographical area. The Europian countries along with some other countries like Australia developed cattle breed in this way. But we are importing germplasm of exotic cattle breed (like that of Jersey, Holstein etc., all are *Bos taurus*) and crossbreeding our native “*Deshi*” or “*Non-descriptive*” cattle with this, castrating the native bulls. This process is in practice for last a few decades and now it is very difficult to find even sufficient number of our native cattle in many agro-climatic areas of our country for development of any new breed from them.

Dr. S. Pattanayak

Associate Editor
Exploratory Animal and Medical Research

***Cite the article as:** Pattanayak S.(2013). Human health impact of bovine Beta-casomorphin-7 of milk — a question for milk products or our breeding policy ? *Explor.Anim.Med.Res.* 3(2): 93-94.

Explor. Anim. Med. Res.,
Vol.3, Issue - 1, 2013, p. 5-6

ISSN 2277- 470X (Print), ISSN 2319-247X (Online)
Website: www.animalmedicalresearch.org

Editorial

USE OF 'VACCINE VIAL MONITOR' IN ALL ANIMAL AND BIRD VACCINES – A DEMAND OF THE DAY

Vaccination is the best way for prevention and control of infectious diseases. Starting from the experiments of Luis Pasteur, we have crossed many milestones to reach the present day status of vaccination. Many dreadful diseases of the past are in the history now-a-days for the constant research and development in the field of Vaccinology. But we are not at the position to control some diseases in our country in spite of development of excellent vaccines against them. There are many reasons behind this, but failure to maintain cold chain is the main reason which lies between the production and the use of the vaccines.

During 1979, World Health Organization (W.H.O.) conceived the concept of Vaccine Vial Monitor, where p- toluenesulfonate was used as the chemical for the purpose. Research, trial and discussion was going on and during 1988, a new type of chemical, di acetylene polymers came in the field with better performance. India urged WHO for assistance in supplying Vaccine Vial Monitors (VVM) on locally produced Oral Polio Vaccine during 1996. In 1999, WHO and UNICEF issued a joint statement advocating the use of VVMs on all vaccines. WHO hold a regional meeting on 2003 with vaccine manufacturers in New Delhi to accelerate expansion of use of VVMs. In 2006, WHO issues new Performance, Quality and Safety (PQS) product specifications and verification protocol for Vaccine Vial Monitors.

Vaccine Vial Monitor is actually a colored circle with a very faint colored square inside it. The inner square of the VVM is made of heat sensitive material that is light at the starting point and become darker with exposure to heat. At the discard point of a vaccine vial, the inner square is the same color as the outer circle. This reflects that the vial has been exposed to a level of heat so that the vaccine degraded beyond acceptable limits. The inner square will continue to darken if get further heat exposure.

Four types of VVM are available to use them either on the label or on the top of the cap or on the neck of the ampoules depending on the type of vaccine (liquid or freeze-dried).The comparative efficacy of the Vaccine Vial Monitors is as follows.

Category (Vaccines)	No. of days to end point at 37^0C	No. of days to end point at 25^0C	Time to end point at 5^0C
VVM 30 (High stability)	30	193	More than 4 Years
VVM 14 (Medium stability)	14	90	More than 3 Years
VVM 7 (Moderate stability)	7	45	More than 2 Years
VVM 2 (Least stability)	2	N/A#	225 days

Not Available

* Source : WHO website

Human health is not protected if the health of the animals and birds are not protected. Agents of many zoonotic diseases may cross the species barrier in various ways to infect and even to bring epidemic among human population.

If we consider the vaccination of animals and birds, we can easily assume that the chances of failure of vaccination among the animals and birds reared in the backyard farms is far more than human vaccines due to the reasons of transport of vaccines to the door of the farmer and relatively poor cold chain facility in the concerned field. Use of a degraded vaccine on any animal or bird can cause many serious types of problems like false certification, acceleration of spread of disease, reaction of chemicals of degraded vaccine etc. So, use of Vaccine Vial Monitor is very much important in the field of vaccination of animals and birds. The subject needs serious and immediate consideration, otherwise it will appear like that the boon of science is with us, but we are not ready to accept it.

Dr. S. Pattanayak
Associate Editor
Exploratory Animal and Medical Research